



ASTROLOGY

SENSE OR NONSENSE?

BIMAN BASU

The practice of astrology is older than astronomy—the scientific study of the cosmic objects. But astrology cannot be classified as a scientific discipline because it is basically a product of human ignorance and fear. Today we know what the stars and planets are and what makes them move. There is no known mechanism by which their position in the sky can influence or control human fate. Most people go to astrologers out of fear, in the hope of assuaging life's great anxieties. This book is primarily aimed at presenting in a logical manner the elements of astrology as practised and to show why the assumptions and methodology used by astrologers for making forecasts on the basis of birth charts or horoscopes are incompatible with the method of science.

Winner of the 1994 NCSTC National Award for the 'best science and technology coverage in the mass media', and the AWIC Honour 2007 for his contribution to children's literature, Shri Biman Basu (b. 1945) has been involved in science popularisation through print and electronic media for more than four decades. He was Editor of the popular science monthly, *Science Reporter* for over three decades. Shri Basu has authored more than 30 popular science books, of which four, *The Story of Man* (1997), *Joy of Starwatching* (1999), *Marching Ahead with Science* (2001), and *Cosmic Vistas* (2002) have been published by the NBT, India.



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B I M A N B A S U



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Preface

The practice of astrology is older than astronomy—the scientific study of the cosmic objects. In fact, the early progress in astronomy happened mainly due to the interest of kings and rulers in astrology. Initially, astrology probably developed as a means of predicting the fates of dynasties, empires and nations and was practised only in royal courts. But soon the notion of personal astrology developed in Alexandrian Egypt and spread through the Greek and Roman worlds about 2,000 years ago from where it came to India. In fact, the astrology practised in India is basically derived from Greek astrology, and there is nothing like ‘Vedic astrology’.

Astrology—whether Western or Indian—cannot be classified as a scientific discipline for various reasons. In fact, it would not be an overstatement to say that astrology is a product of human ignorance and fear. Although people who lived 3,000 years ago were excellent sky watchers, they still could not explain everything they observed. They could not explain the regular change of the pattern of stars in the night sky, the changing phases of the Moon, and the apparently erratic motion of certain star-like objects in the night sky. They also could not explain the sudden appearance of comets—the strange-looking ‘stars with tail’ that seemed to appear from nowhere. It is quite possible that these early people also found that some events in their life appeared to be linked with the appearance of some constellation or the

position among the stars of some of the 'star-like' objects that appeared to move erratically. This may have led them to believe that the position of the celestial bodies had an influence on their life. But that was several thousand years ago, when human knowledge of the universe was limited to naked-eye observation and astronomy was not yet a scientific discipline.

Today we have a reasonably clear idea of the expanse of the universe and the real nature of stars and planets. Stars, except our Sun, are too far away to have any effect on Earth or its inhabitants. All the planets have been explored at quite a close range by space probes, many of which have even landed on them. Humans have set foot on the Moon. From our present knowledge of the planets, on the basis of scientific data and images sent back by space probes, we know that the planets are made up of the same elements as our Earth although the composition of each planet differs. Comets no more arouse fear in our minds because we know where they come from and how they move.

There is nothing to support the belief that planetary positions at the time of our birth or any other time can decide our personality or fate, as astrologers would like us to believe. But unfortunately, despite so much information being available about the planets and the stars and constellations people still believe in astrology and go for expensive rituals and gemstones to counter 'evil influences' of planets. Almost every other television channel today devotes hours every day to telecast astrological 'forecasts' and even suggests astrological solutions for viewer's problems. Most newspapers carry daily astrology columns.

This book is primarily aimed at presenting in a logical manner the elements of astrology as practised and to show why the assumptions and methodology used by astrologers for making forecasts on the basis of birth charts or horoscopes are incompatible with the method of science. But

it does not claim to present an exhaustive account of the various astrological practices in use. I do not profess to be an expert on astrology although I have reasonably good knowledge of astronomy. So I have stressed on only those astronomical parameters or factors used in astrological calculations that *prima facie* appear absurd and contrary to accepted scientific theories.

The first four chapters are devoted to history of astronomy to put the deficiencies of astrological assumptions in proper perspective. I have also included the findings of a few carefully designed tests conducted to validate astrological predictions, all of which revealed negative results.

I am grateful to the Chairman and Director of the National Book Trust, India for assigning me to write this book. The editorial suggestions from Ms Kanchan Wanchoo Sharma were invaluable in enriching the content of the book.

If the book is able to dissuade even a small percentage of its readers from going to astrologers, I would consider my effort worth the labour.

BIMAN BASU

Nature of the Universe

Since the dawn of civilization, humans have wondered about the cycle of day and night, and about the Sun, Moon and the stars. It was probably the early human ancestors, with well-developed brain and an erect posture who first looked up and marvelled at the sky and the various phenomena going on there. The daily movement of the Sun across the sky from east to west, the changing phases of the Moon, and the changing pattern of stars in the night sky with changing seasons must have aroused curiosity in early humans as it does in us even today. But till about 400 years ago, the only means humans had at their disposal to observe the sky was a pair of unaided eyes. Their vision of the Earth, the sky and the universe was based solely on visual observations and their fertile imagination.

The Sun and Moon

The movement of the Sun in the sky did not pose much of a problem for the ancients—it rose and set daily, more or less with a regular pattern, moving northward during summer and southward during winter. More puzzling was the behaviour of the Moon. Unlike the Sun, neither did it rise or set at any fixed time during the day nor did its shape remain the same. It waxed and waned over a period of about a month, disappearing totally in between. Today we know that the waxing and waning of the Moon is an illusion caused by the changing position of the Moon relative to the

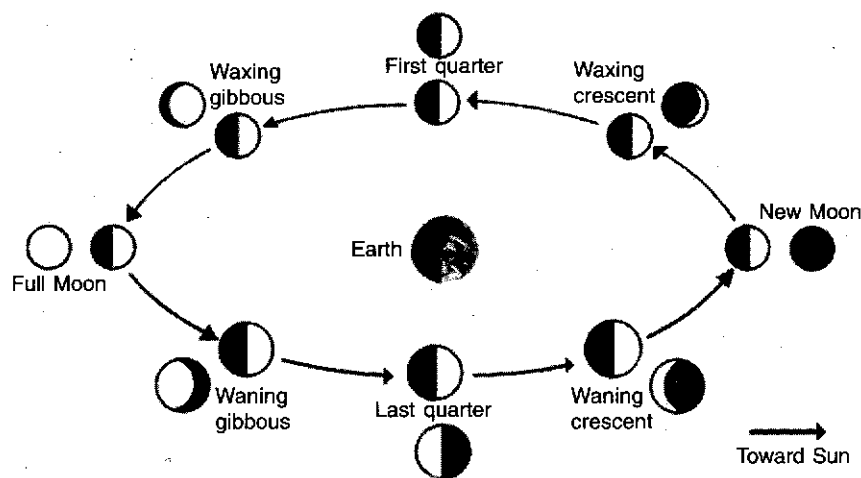


Fig. 1: The phases of the Moon are caused by the changing position of the Moon relative to the Earth and the Sun.

Earth and the Sun (Fig.1). As the Moon goes round the Earth and the angle between the Moon and the Sun as seen from Earth changes, and we see different portions of the Moon's illuminated face—growing from a thin crescent through the gibbous phase to Full Moon and then again through the gibbous phase to a crescent to New Moon when it becomes invisible.

Sometimes, the ancients saw Full Moon darken to a reddish hue (*Plate I, a*) and then regain its brightness after some time. But more frightening was the disappearance of the Sun behind a dark shape, which occurred only on some New Moon days. When it happened, the day suddenly turned into night, birds returned to nest, animals behaved strangely and everything appeared eerie (*Plate I, b*). Of course, the Sun always came out in its original glory in the end. But it was always a terrifying experience. Today we know that these phenomena are nothing but lunar and solar eclipses, of which our ancestors were totally ignorant, and

took them to be ill forebodings. It is no wonder that we have so many myths about eclipses that spread scare among people.

But lack of tools did not come in the way of some of the ancient civilizations and prehistoric stone-age cultures in understanding practical geometry and the motions of the celestial bodies. Around 3100 BC, advanced civilizations flourishing in India, China, Egypt and Babylon had their own systems of astronomy, inextricably mixed with astrology, mythology and religion. These ancient civilizations used their knowledge of the motions of the celestial bodies to make calendars and predict regular celestial events for organising various religious rituals.

Aristotle's Universe

Early ideas about the universe were primarily based on everyday observations and common sense. One of the earliest accepted models of the universe is credited to the Greek philosopher Aristotle, who lived in the 4th century BC. His was essentially an Earth-centred or geocentric universe. He argued that humans could not inhabit a moving and rotating Earth without violating common sense perceptions. (If the Earth were moving we'd all fall over!) So, in the Aristotelian system, the Earth was fixed at the centre of the universe. The four 'elements'—earth, water, air and fire—were naturally disposed in concentric spheres, with earth at the centre, surrounded respectively by water, air and fire. Outside these were the invisible spheres on which the celestial bodies rotated (Fig. 2). Such an idea was not surprising, because from land we can see water around and the sky above, from where the hot Sun gives us light and heat.

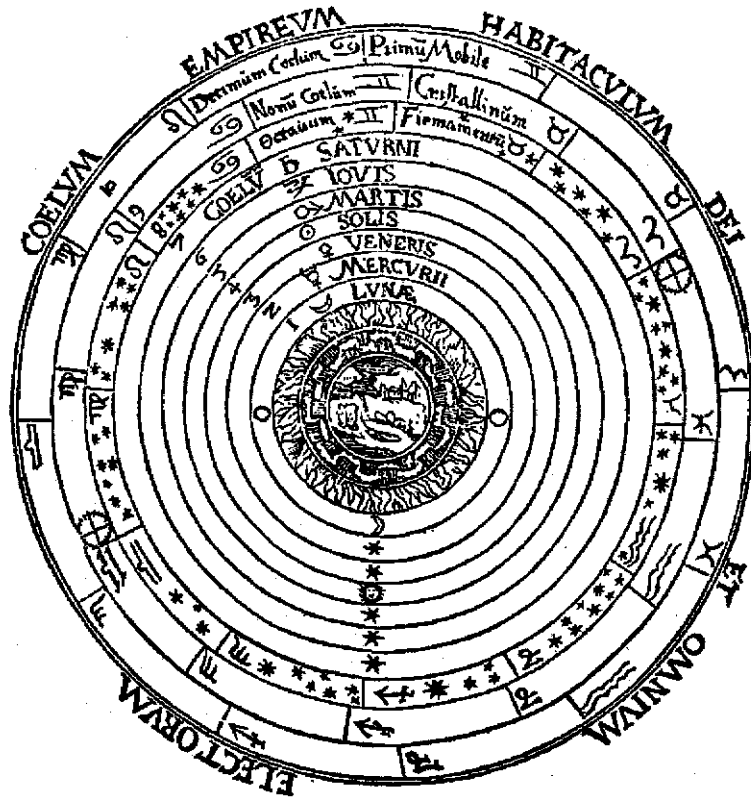


Fig. 2: In the Aristotelian system, the Earth was fixed at the centre of the universe.

Ptolemy's System

One of the main problems with the geocentric, or Earth-centred, model of the universe was that it could not explain all the observed motion of the celestial bodies satisfactorily. For example, it could not explain why the pattern of stars visible at night changed with seasons, or why the Moon waxed and waned over a period of one month. But one of the most troubling observations concerned the apparent motion of the planets against the starry background. Unlike the Moon, which steadily moved eastward against the

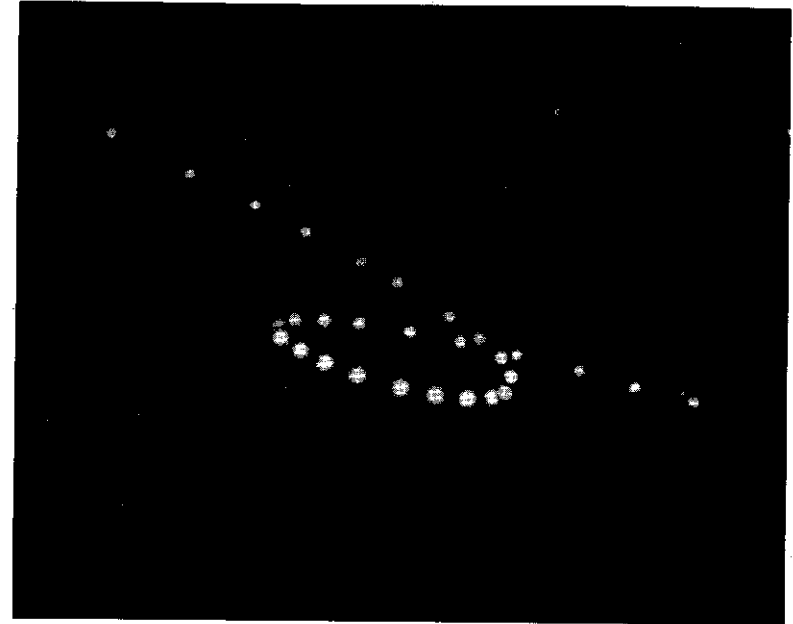


Fig. 3: Planet Mars is known for its 'retrograde motion' during which it appears to move in a direction opposite to its normal motion in the sky.

background of stars each day, or the stars themselves, which moved westward a bit every night, the planets appeared to move without any set pattern. Normally they appeared to move westward against the background of the stars; but occasionally they would appear to stop in their paths and then move eastward (which astronomers call 'retrograde motion'). Again, they would appear to stop and again start moving westward, as in the beginning (Fig. 3). This cycle would be repeated after different intervals of time for different planets. No simple model of celestial bodies revolving around the Earth could explain such unusual motion. So, early astronomers took recourse to all sorts of complicated orbits, epicycles (a circle that rolls around another circle) and other weird mechanisms to account for the apparently wayward motion of the planets.



Fig. 4: Claudius Ptolemy

To explain the motion of the planets, the 2nd century Greek astronomer Ptolemy (Fig. 4) (full name Claudius Ptolemaeus), who lived in Alexandria, proposed a complicated system of planetary motions in his famous work *Almagest*. Like others of his time, Ptolemy believed the Earth to be stationary at the centre of the universe and all the planets, the Sun, Moon and the stars

revolving around it. To explain the various apparent motions of the celestial bodies in the sky, he proposed a complicated clockwork model of the universe. He imagined the planets to be revolving around small circles called epicycles at a uniform rate, while the centres of the epicycles moved around in a larger circle whose centre was the Earth. In this model, the stars were thought to be fixed to the inside of an invisible sphere, which rotated westwards (Fig. 5).

Ptolemy's epicyclic model could explain the observed motions of the planets quite satisfactorily and was accepted by most astronomers for almost 15 centuries. But in course of time, with more accurate study of planetary motions, astronomers found that they had to modify the Ptolemaic model by adding epicycles to the epicycles. Eventually the model became too cumbersome and complicated and many astronomers started finding it unconvincing.

A Rotating Earth

The great Indian astronomer Aryabhata (Plate II), who lived around AD 500, also believed that the Earth was at the centre

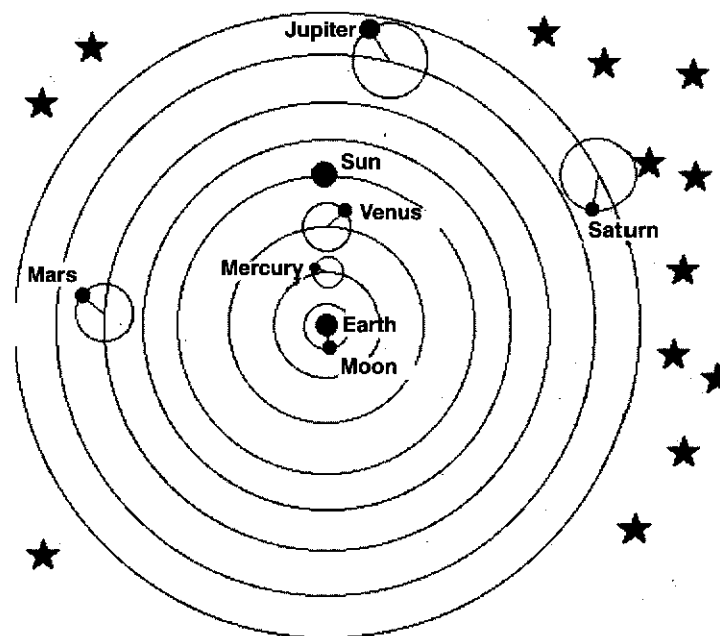


Fig. 5: Ptolemy's epicyclic model explaining the apparently erratic motion of planets.

of the universe. Like Ptolemy he also considered the planets to move in epicycles to account for their retrograde motion in the sky. But in one respect he was ahead of Ptolemy. He was the first to put forward the idea that the Earth, which he said was spherical, like the 'kadamba' (*Anthocephalus indicus*) flower (Fig. 6), rotated on its axis to cause day and night. He said, "Just as trees and objects on the river bank appear to move in the opposite direction to a person riding in a boat, the stars appear to move from east to west in the night sky because of the rotation of the Earth from west to east."

Early Indian astronomers had good knowledge of astronomical phenomena such as eclipses. Contrary to the Puranic idea of *Rahu* and *Ketu* devouring the Sun or the

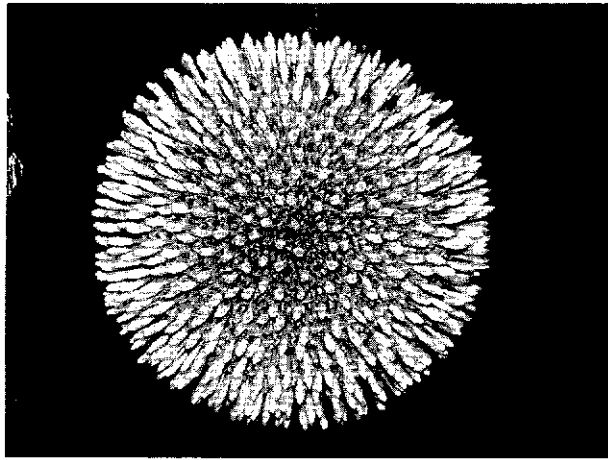


Fig. 6: The spherical flower of 'kadamba' (*Anthocephalus indicus*).

Moon to cause solar or lunar eclipse, Aryabhata held the view that eclipses were caused by the Moon obscuring the Sun and the large shadow of the Earth falling on the Moon respectively.

Another Indian astronomer Varahamihira (Fig. 7), who lived around AD 6th century, exploded the *Rahu-Ketu* myth



Fig. 7: Varahamihira



Fig. 8: Bhaskara II

by suggesting that the real cause of a lunar eclipse is the entry of the Moon into the Earth's shadow and that a solar eclipse is caused when the Moon 'enters' the Sun. Bhaskara II (Fig. 8), who lived in AD 12th century, gave a very clear and lucid exposition of eclipses. He suggested that the orbit of the Moon being below that of the Sun, just as a cloud moving from behind covers the Sun, so does the Moon; moving faster, it covers the Sun from behind causing it to obscure the Sun.

So, we see that by AD 12th century some Indian astronomers had a fairly good idea about the shape and rotation of the Earth and probable cause of eclipses. But there was still no satisfactory theory about the position of Earth in relation to the Sun, Moon, and the planets till the Polish astronomer Nicolaus Copernicus came out with his Sun-centred model of the universe.

The Sun at the Centre

The idea of Earth, the abode of mankind, being at the centre of the universe was deeply ingrained in the minds of the people for thousands of years and was accepted as a religious dogma, and no one dared to change it. Although as early as the 4th century BC the Greek mathematician and astronomer Aristarchus of Samos had proposed a Sun-centred universe, it took 11 centuries for the idea to be revived. It was the genius of the 15th century Polish astronomer Nicolaus Copernicus (Fig. 9) that finally freed the human mind from the shackles of Ptolemy's Earth-centred universe.

Copernicus was born in 1473 in Torun, Poland. He became interested in the study of astronomy when he joined the University of Krakow in 1491. In 1497, he was sent to the University of Bologna in Italy for further studies. It was at Bologna that he became acquainted with the astronomical ideas of the day and made his first astronomical observations. He later joined the University of Padua to



Fig. 9: Nicolaus Copernicus

study law and medicine. After his studies in Krakow and Padua, Copernicus appears to have planned a systematic programme of astronomical studies. He did not make extensive observations, but did enough to enable him to recalculate the paths of the Sun, Moon and the planets around the Earth. He published 27 such observations made during the years 1497-1529.

In 1500, when Copernicus became a professor of astronomy at the University of Rome, he taught the traditional Ptolemaic astronomy, but he was never fully convinced of the idea of an Earth-centred universe. Once in 1502, while lecturing on the design of the universe he said, "The Earth is the centre of the universe; the Sun, Moon and the five planets revolve around our majestic Earth in a perfect circle. Beyond all these are the all-encompassing fixed stars. These are basic truths which are described by the great Claudius Ptolemy more than 1,500 years ago and which are evident to the senses."

A bright-eyed young man stood up to ask a question. "Learned professor", he spoke with a low voice, "did not the ancient Greek philosopher Pythagoras dispute this, saying that the Earth was not at the centre of the universe?" (Fig. 10). Copernicus was about to respond, as he had many times before, asserting the ideas of Ptolemy. But this time he hesitated to do that. He had so little faith in his usual answer that he dismissed the class and abruptly left the room. After three years of teaching something that he did not believe in, Copernicus made up his mind to resign and return to his home in Poland to devote himself to proving to his own satisfaction whether Ptolemy and the learned professors of his time were right or wrong.

Unanswered Questions

Copernicus' disbelief in Ptolemy's model probably arose out of its many inconsistencies and its inability to satisfactorily

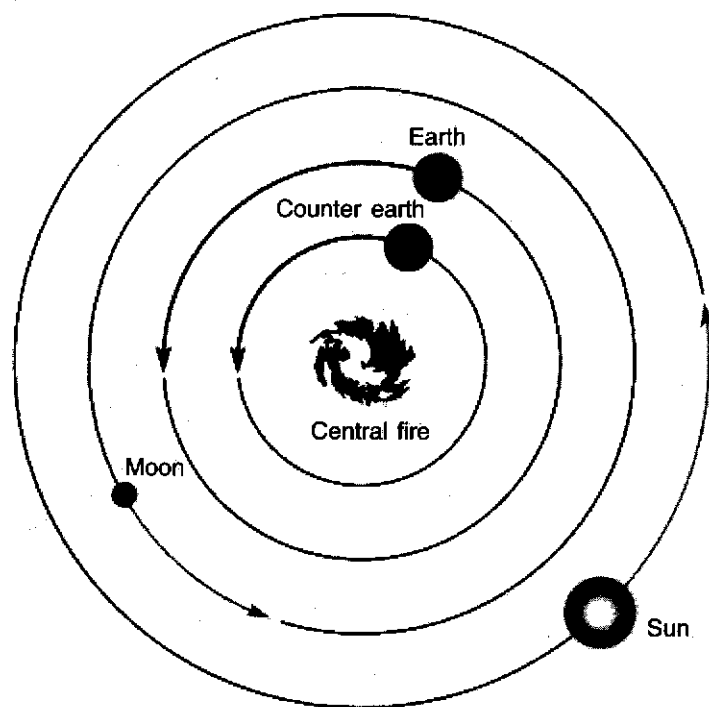


Fig. 10: Pythagoras did not believe in an Earth-centred universe. He proposed that the Earth went round a central fire.

explain many of the observed facts. For instance, he was never quite happy with Ptolemy's cycles and epicycles, which made the model unnecessarily complicated. Further, it also could not explain why the brightness of the planets changed widely from time to time, or why the Moon showed phases, or why Mercury and Venus never rose much above the horizon. Copernicus also wondered: If the Sun revolved around the Earth in the fixed orbit of a perfect circle, how could one account for the change of the seasons? His was a truly scientific mind.

After his return to his hometown in Poland in 1506, Copernicus practised as a physician and also served the

church. In addition, like a true scientist he began his own observations of the sky in his spare time. Nights would find him in the tower of his mountain-top home, observing the stars and planets, making notes of their positions and reading all available material written by earlier astronomers. But Copernicus did not have the benefit of the facilities that today's astronomers enjoy. The telescope had not yet been invented and for much of the year in his native place the local weather reduced the visibility of the sky. Naturally, progress was slow.

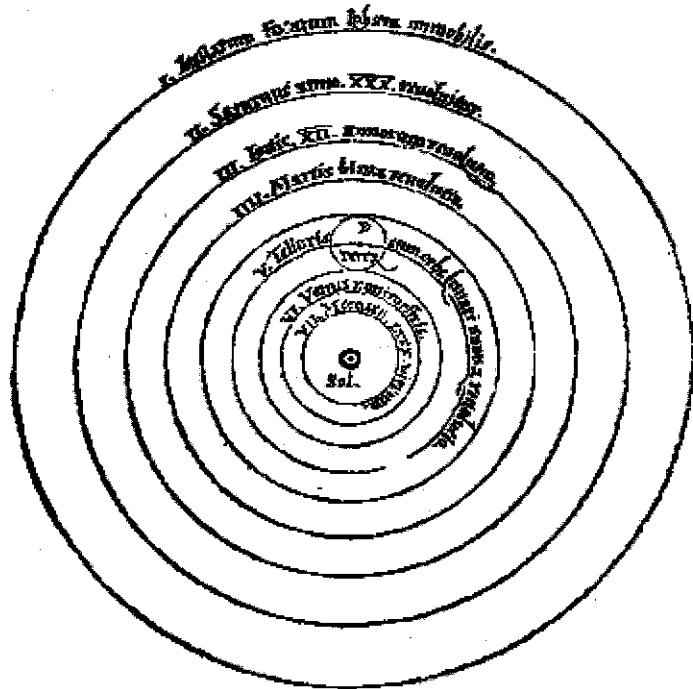
But nothing could dampen the spirit of this Polish astronomer. Using mathematical formulas and his own theory of the movement of the planets, Copernicus predicted the positions of Venus, Mars, Jupiter and Saturn. Later, he anxiously scanned the sky as the years went by to see whether his calculations were correct. To his great satisfaction, his predictions came out to be true; the planets were seen almost where he had predicted them to be. At last his doubts had been proved right. He now had evidence to show that the Ptolemaic theory of an Earth-centred universe was incorrect. He proposed to replace Ptolemy's theory with a model in which the planets, including the Earth, went round a centrally situated Sun, with the stars in the vast cosmos surrounding them all (Fig. 11). This was an achievement of tremendous scientific significance.

Retrograde Motion of Planets

What had actually prompted Copernicus to think of a Sun-centred model was the apparent looping motion of the planets, especially Mars, in the sky during which, for some time, they appeared to move backward and then forward in the background of the fixed stars. It took the genius of Copernicus to realise that these loops, which Ptolemy had sought to explain by epicyclic orbits, did not really occur, but were perceived as such due to the different orbital speeds

NICOLAI COPERNICI

net, in quo terram cum orbe lunari tanquam epicyclo contineri diximus. Quinto loco Venus nono mense reducitur. Sextum denique locum Mercurius tenet, octuaginta dierum spacio circumcurrens, in medio vero omnium residet Sol. Quis enim in hoc



putcherimo templo lampadem hanc in alio uel meliori loco poneret, quàm unde totum simul possit illuminare. Siquidem non inepte quidam lucernam mundi, alij mentem, alij rectorem nunciant. Trimegistus uisibilem Deum, Sophocles Electra totumque omnia, in profectio tanquam in solio regali Sol residens circumagentem gubernat Astrorum famuliam. Tellus quoque minime grandatur lunari ministerio, sed ut Aristoteles de animalibus ait, maximè Luna cum terra cognatione habet. Concipit interea à Sole terra, & impregnatur annuo partu. Inuenimus igitur sub hac

Fig. 11: The Sun-centred model proposed by Copernicus that could explain most of the observed astronomical phenomena.

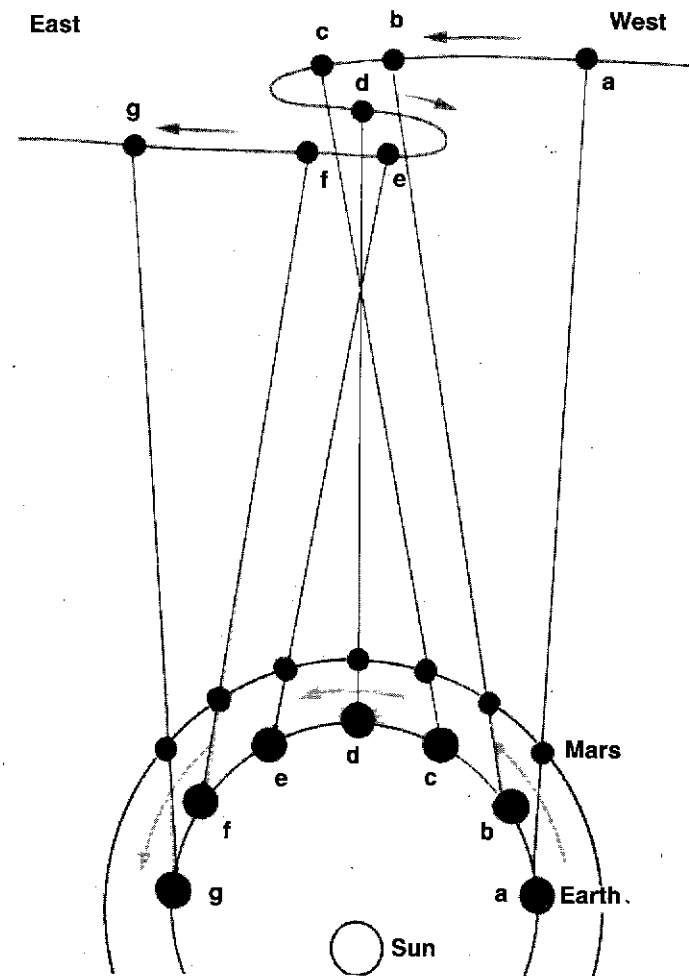


Fig. 12: The retrograde motion of Mars is perceived as such due to the different orbital speeds of the Earth and Mars around the Sun.

of the Earth and the planets around the Sun (Fig. 12). For example, as we know today, Mars being further away from the Sun, it takes about twice as long to go around the Sun as compared to the Earth. As a result, Earth periodically

'overtakes' Mars in its orbit and it is then that Mars appears to move 'backwards' in the sky. Similarly, since the orbits of Mercury and Venus are smaller than Earth's orbit, from Earth these two planets can never be seen far from the Sun. It is for this reason that none of these two planets can be seen in the sky for more than a few hours before sunrise in the dawn sky or after sunset in the evening sky and never at midnight.

Thus Copernicus' Sun-centred model could in one stroke solve the mystery behind the apparent erratic motions of the planets and also do away with the need for the complicated epicyclic orbits to explain them. He showed by his calculations that the motions of all the planets follow precise mathematical laws as they go around the Sun in their respective orbits.

Although Copernicus had found the real clue to the motion of the planets by 1514, he was hesitant to make it public, afraid of being ridiculed and rejected by the Church, which had little regard for scientific ideas. His fear was, however, not unfounded—dethroning Earth from its hallowed position as the centre of the universe could be construed as blasphemy. And without the Church accepting it, it would be impossible to get the Western world accept the new theory. So, Copernicus decided not to publish his revolutionary theory, at least not for the time being. The world had to wait for almost 30 years before his work appeared in print; on the day he died in 1543.

Between 1510 and 1514, Copernicus prepared a brief, anonymous paper to summarise his new idea. It was titled *De hypothesibus motuum coelestium a se constitutis commentariolus* (A Commentary on the Theories of the Motions of Heavenly Objects from their Arrangements). In the paper, Copernicus put forward the suggestion that the apparent daily motion of the stars, the yearly motion of the Sun, and the apparently erratic behaviour of the planets resulted from the Earth's daily rotation on its axis and yearly

revolution around the Sun, which he said was stationary at the centre of the planetary system. Therefore, the Earth, Copernicus proclaimed, is the centre of not the universe but only of the Moon's orbit.

Initially, for fear of ridicule, Copernicus privately circulated the paper among his friends. As the years passed, he further developed his arguments with diagrams and mathematical calculations. In 1533, he made a presentation of his ideas before the Pope in Rome, who is said to have given his approval. After his presentation before the Pope, Copernicus was formally requested by his friends in 1536 to publish his findings. But he continued to hesitate for fear of retribution. It was left to his friends to go ahead and take up the responsibility of getting the work into print. A copy of Copernicus' revolutionary work, titled *De revolutionibus orbium coelestium* (On the Revolutions of the Celestial Spheres) is believed to have been brought to the great astronomer at his bedside on the last day of his life, on 24 May 1543. He never actually read the printed book that changed for all times the worldview of the universe by putting the Sun in its rightful place and giving a new perspective to our understanding of the cosmos. No wonder, the work of Copernicus has been described as "the greatest step ever taken in astronomy."

The publication of Copernicus' theory had a vast influence on the development of astronomy and science in general, but not without some opposition. While Copernicus himself did not suffer any repercussions for attacking the established and Church-approved view of the universe, later scientists, the famous Italian Galileo among them, who went on to provide the proof of Copernicus's ideas, did suffer at the hands of those who did not want to give up the Earth-centred ideas of the universe.

But because of its extreme simplicity and elegance, the Copernican system appealed to a large number of



Fig. 13: Tycho Brahe

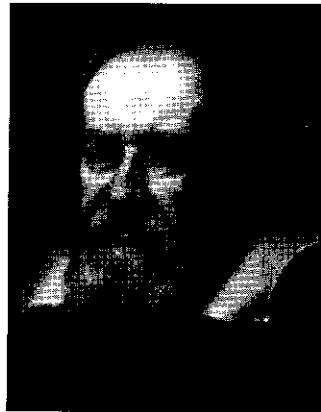


Fig. 14: Galileo Galilei

independent-minded astronomers and mathematicians. They not only accepted it but also expanded and advanced it. Apart from dethroning Earth from the centre of the universe, the Copernican heliocentric system also vastly expanded the size of the universe compared to what was believed earlier, as it placed the starry sphere far distant from Earth and the planets.



Fig. 15: Johannes Kepler

But the Copernican model, too, had its deficiencies. It presumed the orbits of the planets to be circular, which as we know today is not quite true. The Copernican model also did not provide any clue as to what made the planets go round the Sun. Following the death of Copernicus in 1543, three notable astronomers—Tycho Brahe (Fig. 13), Galileo Galilei (Fig. 14) and Johannes

Kepler (Fig. 15)—carried his work forward. Between 1560 and 1640, they made a great impact on the progress of astronomy.

In 1687, Isaac Newton (*Plate III*) came up with his universal laws of gravitation that provided a plausible explanation of what made the planets move around the sun.

So we have seen how all scientific theories develop through repeated refinements. As new deficiencies are encountered, changes are made to remove them. The theory of the universe has also had to pass through many stages before it could account for all the observed celestial phenomena.

Astronomy in India

Among the earliest practitioners of astronomy were the Vedic people who lived in India about 3,500 years ago. The oldest astronomical text in India is the *Vedanga Jyotisha*, dating to about 1400 BC, in which we find certain symbolic hymns and references from which we can learn a lot about the astronomical ideas of the Vedic Indians.

The Vedic people studied the sky not for understanding celestial mechanics or cataloguing the stars, but mainly for religious purposes—for deciding the auspicious dates and times for various rituals, which were an essential part of their daily life. The Vedic priests were not only keen observers but also possessed good knowledge of the course of the Sun in the sky, the path and phases of the Moon, the planets, occurrences of eclipses and the like, and were aware of equinoxes and solstices. Whether their rituals had any practical utility we don't know; may be they were an essential part of their social custom. But in the process of observing and compiling the vast astronomical data, the Vedic people have left behind a wealth of observational knowledge about the motions of the Sun, the Moon and the planets, in the form of Vedic *samhitas* and *brahmanas* and other literature.

Sun as God

As in many contemporary civilizations of the past, the Vedic people understood the importance of the Sun in sustaining

life on Earth and worshipped it as god. But they had no idea about its real nature, and understandably so, because they had no means of finding it out for themselves. The *Rig Veda* describes the Sun as the sole light giver of the Universe (which, as we know today, is not quite true), as the cause of the seasons, and as the controller and lord of the world. Sun worship remains in vogue even today (*Plate IV*). This is not surprising, because the Sun was held in such high esteem and worshipped in many other contemporary civilizations too, the most prominent being the Nile Valley civilization in what is now Egypt, which flourished on the banks of the Nile around 5,000 BC. Of course, we cannot deny the crucial role the Sun plays in sustaining life on Earth; but that is not because it has divine powers but because it is the source of enormous energy in the form of light and heat the origin of which is nuclear fusion. And it is the light and heat of the Sun that sustains life on Earth.

There is no mention of planets in the *Vedanga Jyotisha*, but according to some authorities, Vedic people knew about the Sun, Moon and five planets and may have worshipped them. Although all this may appear ridiculous today, we have to remember that the ideas about the Sun, the Moon and the planets some 3,500 years ago were based on nothing more than simple naked-eye observation and except their motion in the sky, nothing more could be found out about the celestial bodies by this method.

The Calendar Makers

The Vedic people were a highly disciplined community. Their daily routine included various rituals, which they performed as prescribed by their religious texts. They also had some sacrificial rituals, which had to be performed on specific days of the month or the year. Usually these coincided with the transits of the Sun and the Moon across certain star groups (constellations or *nakshatras*) in the sky

or the occurrence of Full Moon or New Moon. The Vedic people needed a good knowledge of the measurement of time in order to correctly predict the times for the various rituals well in advance. Their meticulous studies of the motion of the Sun and the Moon across the various constellations and *nakshatras* in the sky enabled them to use the natural divisions of time caused by these motions for making reasonably accurate calendars.

With their intuitive minds the Vedic priests had developed a thought-pattern to explain the motion of the astronomical bodies. Because of its relatively good visibility and fast movement against the background of stars in the night sky, the Moon became the obvious choice for determining the month. The Vedic people measured the lunar month from Full Moon to Full Moon (a system called *purnimanta*), or from New Moon to New Moon (called *amanta*), a period of a little more than 29 days, as it is done even today. The lunar months, which we still follow, were named after those of the *nakshatras* near which the Full Moon was seen. For example, the first month of the Indian Saka calendar, 'Chaitra' is named after the *nakshatra* 'Chitra' (Spica) in the constellation of Virgo; the month 'Jyaistha' is named after the *nakshatra* 'Jyestha' (Antares) in the constellation of Scorpio and so on (Fig. 16).

Different points in course of the year were marked by celebrations. The year, beginning with the Full Moon in the month Chaitra, was divided into three four-monthly, or *chaturmasya* sacrifices. On the basis of the Sun's position in the sky the year was divided into two halves: *uttarayana*, when the Sun travels north, and *dakshinayana*, when the Sun travels south. Another way of marking the year was by a year-long *diksha*. The year was closed with rites to celebrate *Indra Sunasira* (Indra with the plough) to "obtain the thirteenth month." This thirteenth month was interposed twice in five years to bring the lunar year in harmony with

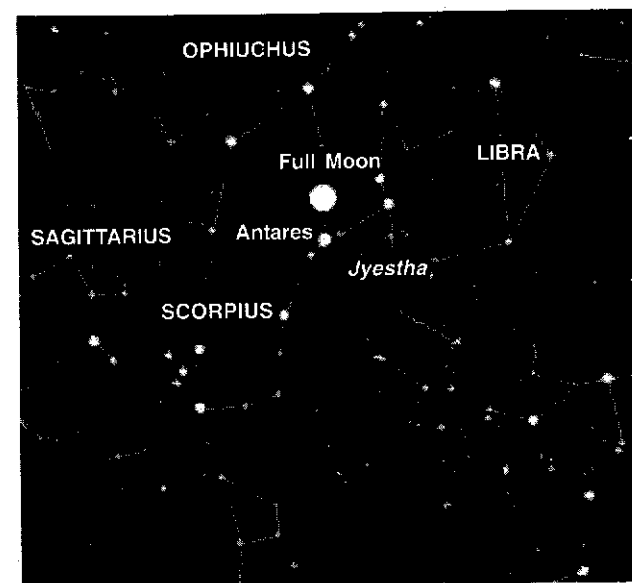


Fig. 16: The Indian month of *Jyestha* is named after the *nakshatra* *Jyestha* near which the Full Moon is seen.

the solar year. This closing rite was to mark the first ploughing, in preparation for the next year. Symbolically, this closing was taken to represent the regeneration of the year.

Thus, the Vedic calendar system was not based purely on the motion of the Moon, but it was a luni-solar calendar; that is, it took into account motions of both the Moon and the Sun. This was a significant achievement of the Vedic Indians because without the addition of the extra month, Hindu festivals, most of which are season-dependent, would have totally gone out of synchrony with the seasons over the years, as it is with the Hejira calendar followed in Islamic countries, which is purely a lunar calendar.

The Vedic people also had a fairly good knowledge of the variation of the day length between summer and winter and also of the summer and winter solstices. However,

unlike the present system of measuring the day from midnight to midnight, which makes the length of the day including night the same irrespective of the month or season, the Vedic people reckoned the day from sunrise to sunrise. This led to wide variation in the length of the day from season to season. The Vedic people also had smaller divisions of the day. The normal day was divided into 30 *muhurtas* (1 *muhurta* corresponding to 48 minutes)—15 *muhurtas* each of day and night. But in summer the longest day had a length of 18 *muhurtas* whereas the shortest day in winter lasted only 12 *muhurtas*.

Although Vedic astronomy was largely observational—with very little effort to find theoretical explanations for the observed phenomena—it made significant contribution to our knowledge of the intricate relationship between the motions of the celestial bodies and the passage of time on Earth. We still use variants of the Vedic system to fix dates of our festivals such as *Holi*, *Diwali*, *Raksha Bandhan*, *Makar Sankranti*, etc., which are decided by the position or phase of the Moon or the position of the Sun in the zodiac.

An interesting aspect of the astronomical knowledge of the Vedic Indians was their knowledge of large numbers, which they used for calculating time. They had developed notions of cycle of years, comprising round numbers of solar and lunar years taken together. They even had developed a system of larger cycles that took into account the revolutions of the planets, as they came back to the same position in the background of stars in the sky.

The *Vedanga Jyotisha*, composed around 1,200 BC, speaks of a five-year luni-solar cycle, called *yuga*. The beginning of the cycle was reckoned from the time both the Sun and the Moon were in the *nakshatra* named *Dhanistha*, which is identified with the present day constellation of Delphinus. During one *yuga*, according to

the scheme, the Sun 'passed' through all the zodiacal constellations five times, and the Moon went through all the *nakshatras* 67 times. This relationship gave the length of a *sidereal* month as 27.31 days and that of a *synodic* month (the period from New Moon to New Moon or from Full Moon to Full Moon) as 29.52 days, which shows the remarkable astronomical and computational knowledge of the Vedic Indians.

It is quite amazing how much wealth of knowledge about the celestial bodies could be amassed by the Vedic Indians merely on the basis of naked-eye observation and mental calculation. One reason may be their skill in mathematics, which enabled them to make highly accurate predictions about astronomical events. But, as mentioned before, the Vedic people did not have any idea about the real nature of the astronomical bodies nor were they aware of the mechanism behind the apparent motions of the various celestial bodies in the sky.

Constellations and *Rashis*

A significant contribution of the ancient sky watchers was the concept of grouping the stars in the sky into 'constellations'. If we look at the clear sky on a dark, moonless night, the view can be bewildering. The number of stars that we can see seems countless. Trying to make any sense of it appears almost impossible. So it was, till about 2000 BC. Then, two developments took place, which had far-reaching impact on the later developments in our understanding of the universe. The first was the grouping of the brighter stars into various patterns called constellations, by the seafaring people who lived on the coast of the Mediterranean to help them navigate at night in the sea or in deserts. The second was the classification of star groups called *nakshatras* on the basis of the daily motion of the Moon in the sky by early Indians.

Sumerian Origins

Seafaring people of the ancient world had sailed the seas and watched the starry night sky for millennia. They were keen observers and could make out patterns in the randomness of the star-filled sky. They could imagine familiar objects outlined by prominent stars; much like a child joining random dots in a puzzle book to form various shapes.

Recognition of the constellations can be traced to early civilizations. The oldest astronomical cuneiform texts, from

the second half of the 2nd millennium BC, record the Sumerian names of the constellations still known as the lion, the bull, and the scorpion. Drawings of these astronomical animals appear on Babylonian boundary-stones of the same period (*Plate V*), and the earlier occurrence of these motifs on prehistoric seals, Sumerian vases, and gaming boards suggests that they may have originated as early as 4000 BC. Old engravings suggesting shapes of the scorpion, lion, hunter (Orion), and the big dipper have also been discovered in China.

Of course, there can be many ways in which a group of stars can be joined to make a pattern. Thus there is nothing sacrosanct about the constellations, except that they are creations of human imagination. No wonder, over the centuries, various civilizations have imagined their own patterns in the stars and given different names to their own constellations. But anything meant for universal use has to be accepted by the international community, and that is what we have today. The constellations we know today have been derived from a group of 48 known to the ancient Greeks and listed by the 2nd century Greek astronomer Ptolemy in his astronomical work *Almagest*. Other constellations were subsequently added to the list. Today, a total of 88 constellations, into which the entire sky is divided, are recognised by the International Astronomical Union.

The earliest constellations were given names of animals or objects with which early civilizations were familiar. So we have Aries (the ram), Taurus (the bull), Leo (the lion), Pisces (the fishes), Libra (the scale) and so on. Some constellations were named after Greek or Roman mythological characters such as Andromeda, Cepheus, Hercules, Pegasus and so on. Also, there were interesting mythological stories associated with some of the constellations, which formed the lead characters in those stories.

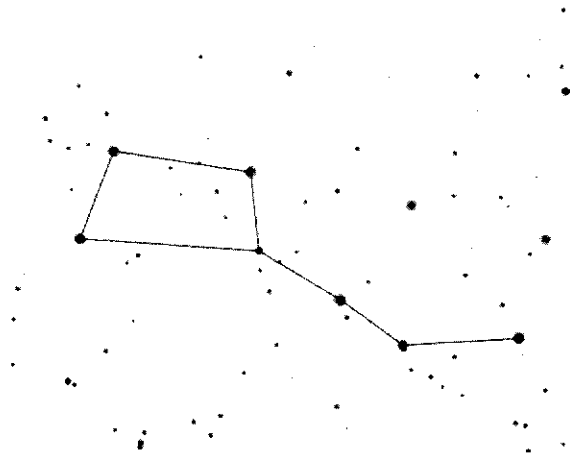


Fig. 17: The pattern of seven stars in the northern sky is known as the "Big Dipper" in the West, but in India the seven stars represent seven sages and the asterism is known as *Saptarishi Mandal*.

In some cases, different civilizations had different names for the same set of stars. For example, in the northern constellation of Ursa Major, the pattern of seven stars forming the tail of the mythical bear is known as the "Big Dipper" in the West, but in India the seven stars represent seven sages and the asterism is known as *Saptarishi Mandal* (Fig. 17).

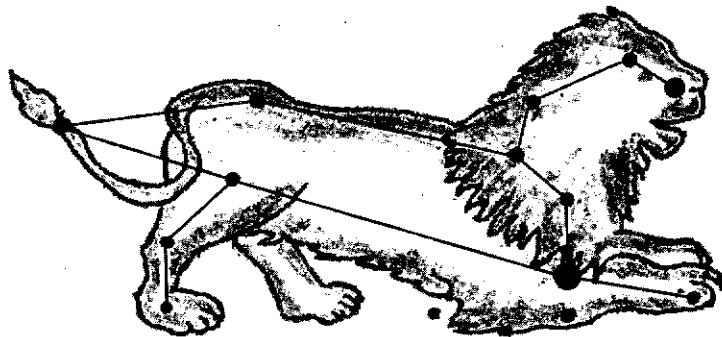


Fig. 18: The constellation of Leo the lion.

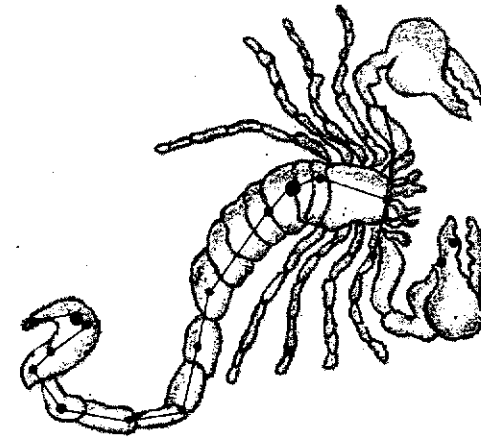


Fig. 19: The constellation of Scorpius the scorpion.

Interestingly, although some of the constellations do loosely resemble the objects they are named after—Leo (Fig. 18), Scorpius (Fig. 19) and Cygnus (Fig. 20) being prominent among them—most others rarely do. To recognise them as the objects they are named after, one would need to have really exceptional power of imagination to find any

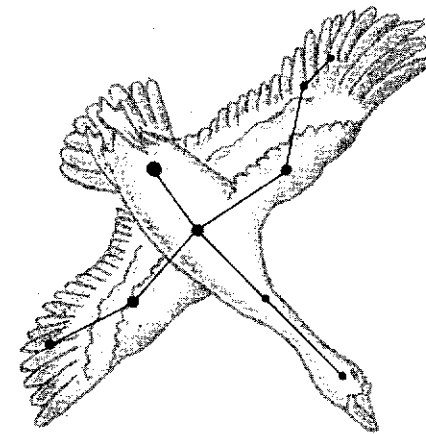


Fig. 20: The constellation of Cygnus the swan.

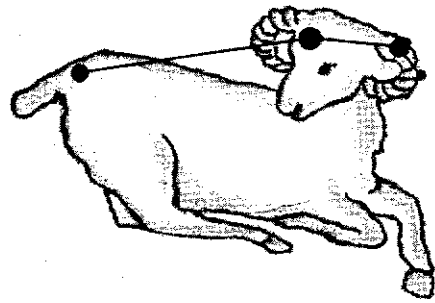


Fig. 21: The constellation of Aries has little resemblance to the ram, the animal it is named after.

resemblance! And to endow them with characteristics of the objects they are named after would be going too far. For example, the constellation Aries (Fig. 21), which in no manner resembles ram—the animal it is named after.

Nevertheless, the grouping of the stars into recognisable patterns did help early sky watchers to better understand the movement of the stars across the night sky, because the constellations could be recognised more easily than the individual stars. The linking of the stars into groups and geometric patterns was also a great help in locating individual stars.

The Zodiac

Astronomers use many imaginary lines for mapping the sky; one of these is the ecliptic. It is the apparent path the Sun appears to take through the sky as the Earth orbits around it. The Moon and the planets are mostly seen within a zone of about 8° on either side of this imaginary line. Since the solar system looks like a flattened disc, the apparent paths of the Sun, the Moon, and the major planets all fall within this zone, as most of the planets orbit in the same plane. This belt-shaped region in the sky on either side to the ecliptic is known as the 'zodiac'. Zodiac means 'circle of animals', as most of the constellations seen in the zodiac are

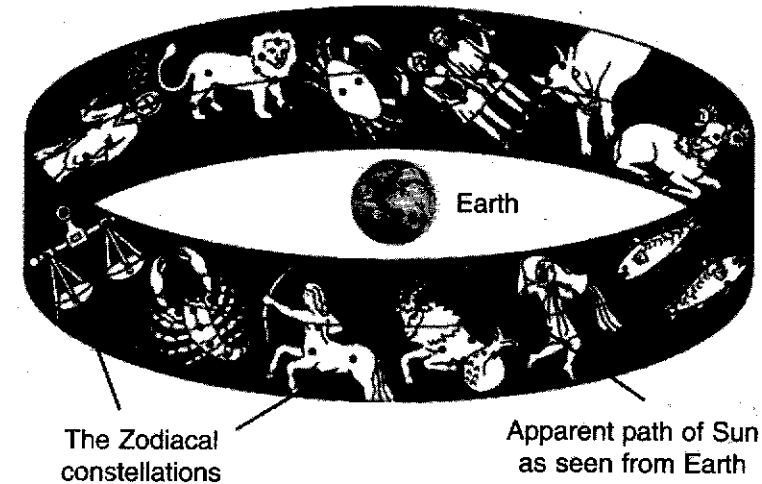


Fig. 22: The Zodiac. Zodiac means 'circle of animals', as most of the constellations seen in the zodiac are named after animals.

named after animals—Aries the ram, Taurus the bull, Leo the lion, Cancer the crab, etc. (Fig. 22).

Astrologers divide the zodiac into 12 equal parts of 30° each (which is astronomically incorrect, as the constellations span unequal spaces), forming the 12 constellations of the zodiac. This division into 12 segments was probably made because there are 12 complete (actually about 12.4) lunar cycles or months in one year. As a result, the Sun 'occupies' each segment, or 'sign' for about one calendar month. The Earth's annual motion around the Sun causes the Sun to appear to shift eastwards through the zodiacal constellations over the course of a year, covering each in one month (Fig. 23). But actually the Sun 'passes' through 13 constellations—Ophiuchus (the serpent bearer) is not included in the zodiac, yet the Sun 'spends' more time in this large constellation than nearby Scorpius. For example, at present the Sun spends just about a week in Scorpius and over two weeks

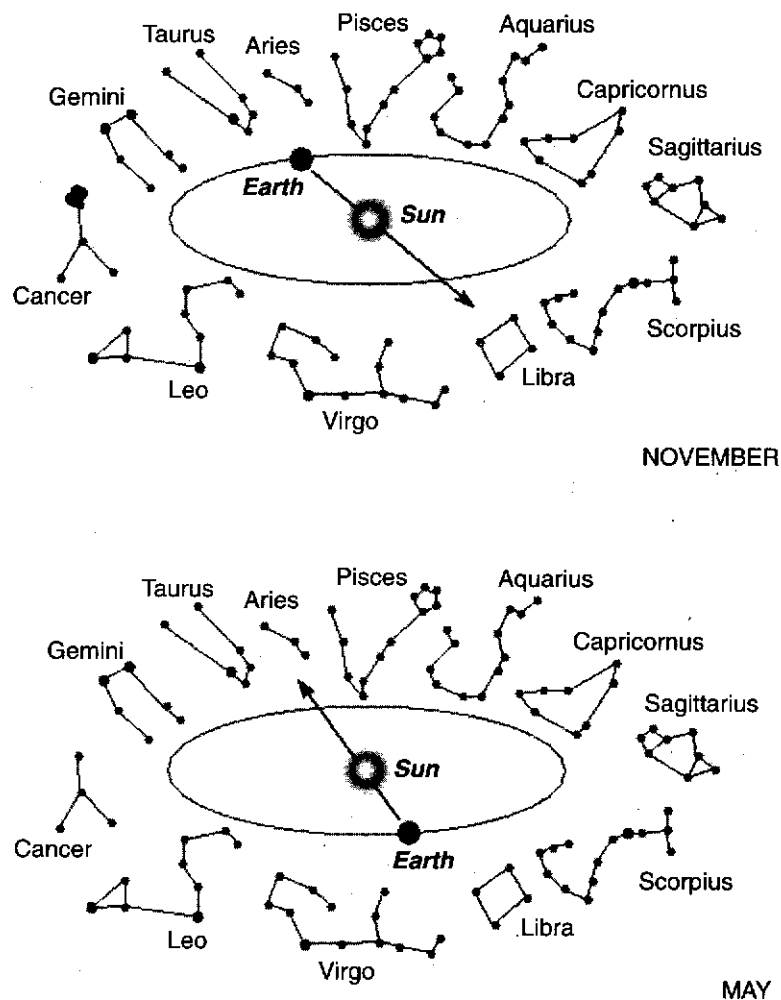


Fig. 23: The Earth's annual motion around the Sun causes the Sun to appear to move eastward through the zodiacal constellations over the course of a year. As a result the constellations visible at night during November are different from those visible during May.

in Ophiuchus. This anomaly is due to the redrawing and adoption of the constellation boundaries by the International Astronomical Union (IAU) in 1930. But astrologers continue to follow the old system.

The dates when the Sun is between the Earth and each of these 13 constellations at present are also different from the traditional dates used by astrologers, which do not take into account the precession of the equinoxes. As can be seen from the table, the Sun signs usually allocated by astrologers on the basis of dates of birth are no more valid in most cases.

Table 1

Constellation	Present dates	Number of days	Traditional dates
Sagittarius	Dec. 18 - Jan. 18	32	Nov. 22 - Dec. 21
Capricornus	Jan. 19 - Feb. 15	28	Dec. 22 - Jan. 19
Aquarius	Feb. 16 - Mar. 11	24	Jan. 20 - Feb. 18
Pisces	Mar. 12 - Apr. 18	38	Feb. 19 - Mar. 20
Aries	Apr. 19 - May 13	25	Mar. 21 - Apr. 19
Taurus	May 14 - Jun. 19	37	Apr. 20 - May 20
Gemini	Jun. 20 - Jul. 20	31	May 21 - Jun. 21
Cancer	Jul. 21 - Aug. 9	20	Jun. 22 - Jul. 22
Leo	Aug. 10 - Sep. 15	37	Jul. 23 - Aug. 22
Virgo	Sep. 16 - Oct. 30	45	Aug. 23 - Sep. 22
Libra	Oct. 31 - Nov. 22	23	Sep. 23 - Oct. 22
Scorpius	Nov. 23 - Nov. 29	7	Oct. 23 - Nov. 21
Ophiuchus	Nov. 30 - Dec. 17	18	—

Origin of the Zodiac

The zodiac probably had its origins among the Assyrians or Chaldeans (people living in an ancient region of Mesopotamia lying between the Euphrates delta and the Persian Gulf, around 1000 bc), although it may have originated among the Babylonians as early as 2500 bc. The Babylonians divided the zodiac into 12 parts, which correspond to 12 constellations: Aries the Ram; Taurus the

Bull; Gemini the Twins; Cancer the Crab; Leo the Lion; Virgo the Virgin; Libra the Scales; Scorpius the Scorpion; Sagittarius the Archer, Capricornus the Sea Goat; Aquarius the Water Carrier; and Pisces the Fish. These constellations are based on Greek myths. In India, the 12 zodiacal constellations are called *rashis*, and are named *Mesha*, *Vrisha*, *Mithuna*, *Carkata*, *Simha*, *Kanya*, *Tula*, *Vrishchika*, *Dhanu*, *Makara*, *Kumbha*, and *Meena*, respectively.

The zodiacal constellations are important because not only the Sun, but also the Moon and the planets are seen to pass 'through' them during their apparent motion in the background of the 'fixed' stars. So the zodiacal constellations provide a convenient yardstick for measuring the daily, monthly and yearly movement of these celestial bodies across the sky. The zodiacal constellations also played a crucial role in casting of horoscopes by practitioners of astrology. Interestingly, although there are Indian names for all the twelve zodiacal constellations, except a few bright constellations like Orion (*Kaalpurush*), Ursa Major (*Saptarishi Mandal*), and Corvus (*Hasta*), few other non-zodiacal constellations find mention in ancient Indian astronomical texts.

Astrologers' obsession with the zodiacal constellations cannot be termed scientific primarily because the constellations are not real physical entities, but mere imaginary shapes—abstract creations of the human mind. More than their shape, which in most cases makes a mockery of their names, there is a still more serious matter that we have to consider when we are talking about constellations. The stars that 'make up' a constellation usually have no physical connection between one another, nor are they fixed in space. Although they appear in the same direction in the sky, the individual stars in a constellation are actually at vastly differing distances from us. Sometimes the stars in a constellation may be as much as 10 to 22 times as far away

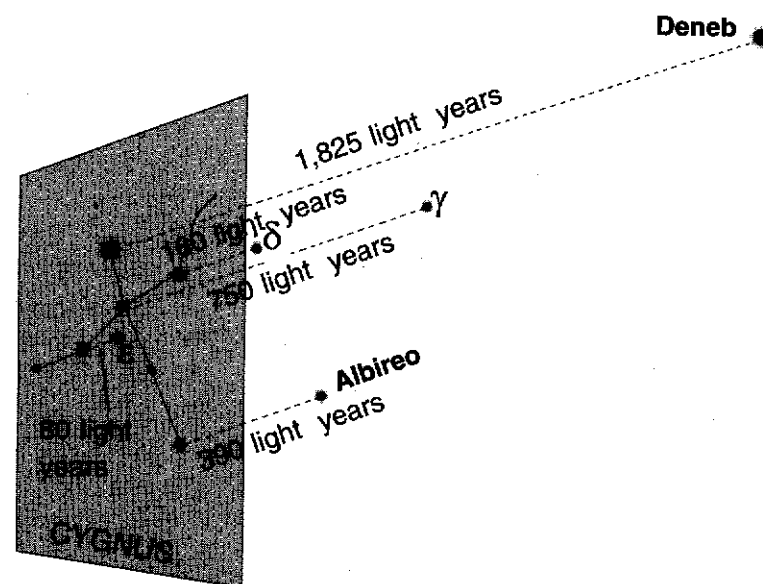


Fig. 24: Although they appear in the same constellation, the bright stars that make up the constellation of Cygnus are situated at vastly different distances from us.

from us as another in the same constellation. For example, the five brightest stars in the constellation of Cygnus the Swan (comprising an arrangement also known as the Northern Cross) are approximately 82, 160, 390, 750, and 1,825 light-years away from the Sun (Fig. 24). They appear as part of the same constellation only because they lie in our line of sight as we look at them from Earth. This is similar to looking at a group of trees from a distance. From far away the trees appear to be arranged in a dense row. But if we go near we find that the trees are scattered randomly at varying distances, with large spaces separating them.

As mentioned earlier, although astrologers consider the zodiac to be passing through 12 constellations, the Sun actually passes through parts of 13 constellations, as currently defined. A large part of the constellation of

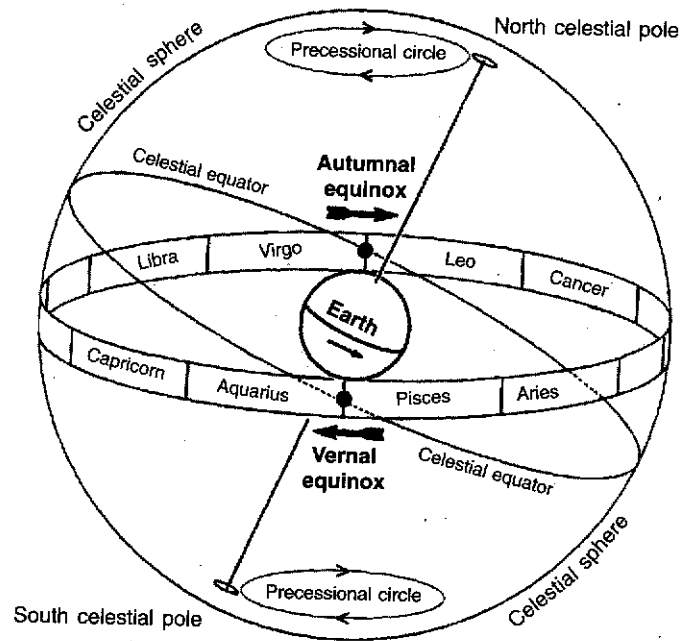


Fig. 25: The slow wobbling of the Earth's spin axis causes the equinox points to slowly move around the ecliptic, making one complete cycle in about 26,000 years.

Ophiuchus lies on the ecliptic, yet it is not counted as a zodiacal constellation. Further, as the Earth's pole precesses, Earth's equatorial plane wobbles in the plane of the ecliptic. This causes the vernal and autumnal equinox points to move around the ecliptic at a rate of about 1° every 72 years, making one complete cycle in about 26,000 years. This precessional movement of the equinox points is called the 'precession of the equinoxes' (Fig. 25, Plate VI).

Because of the precession of the equinoxes, the positions of the constellations in the sky have drifted from the dates of the year with which they were associated thousands of years ago. Thus the popular astrological 'signs' of the zodiac

are not actually those that currently correspond to the sky. Though the vernal equinox is often called the first point of Aries, precession of the Earth's axis has moved it into Pisces, not far from Aquarius. Thus the entire scheme of things relating to the zodiacal signs used by astrologers for casting horoscopes appears to be erroneous.

The Nakshatras

As we have seen, the Moon was of special interest to Vedic astronomers. This interest was mainly due to the much swifter motion of Earth's only satellite across the sky, which places it daily against a different backdrop of stars. No other celestial body moves as swiftly. Vedic astronomers divided the Moon's path in the sky into 27 equal parts, although the Moon takes about $27 \frac{1}{3}$ days to complete it. Each of these parts was called a lunar 'mansion' or a *nakshatra*, each identified by a bright star or a group of stars. Specific stars or asterisms were also termed *nakshatras*. In later periods, the concept of the *nakshatra* played an important role in the development of a reliable calendar system, which remains valid even today.

The oldest system of Indian calendar, known from texts dating back to about 1000 BC, divides the solar year of approximately 360 days into 12 lunar months of 27 days, based on the daily movement of the Moon through the 27 *nakshatras*. The lunar phases or *tithis* were also important for fixing times of religious rites and casting horoscopes. Here again, there is nothing to explain why some *tithis* are considered auspicious and others inauspicious. How can any particular phase of the Moon, which is just a rocky body like the Earth and on which humans have set foot, be inauspicious for certain jobs and auspicious for others? There is no rational, scientific explanation of why it should be so.

The Wanderers

Among the objects in the sky that puzzled early humans most were probably the planets, which seemed to shift position in the background of stars in a random manner. Since the motion of these celestial objects could not be explained with the then existing knowledge of celestial mechanics, it was natural for the ancients to endow each planet with divine powers. Thus Saturn was considered wicked and 'evil', probably because it was the slowest moving in the sky, while Mars was considered the planet of war, presumably because of its red colour (see later). Similarly, Jupiter was believed to be a benevolent planet probably because of its brightness and its 'regular' movement, covering one zodiacal constellation every month.

Observations with telescopes and exploration by space probes during the twentieth century, however, have changed all our early ideas about the stars and planets. They have revealed the real nature of the stars and planets—what they are really made of, how far they are, and why they move in the sky the way we see them moving. What we know about the planets today also tells us that there can be no scientific basis to suggest that the planets can be evil or benevolent, or that they can decide or influence human destiny in any way. But the interesting point is that it was the study of the sky, especially of the star patterns and the planetary positions among them, specifically for astrological purposes that later evolved into the modern science of astronomy, and the early sky watchers had an important role to play in this development.



Plate 1a: When fully eclipsed, the Moon appears reddish-orange in colour.

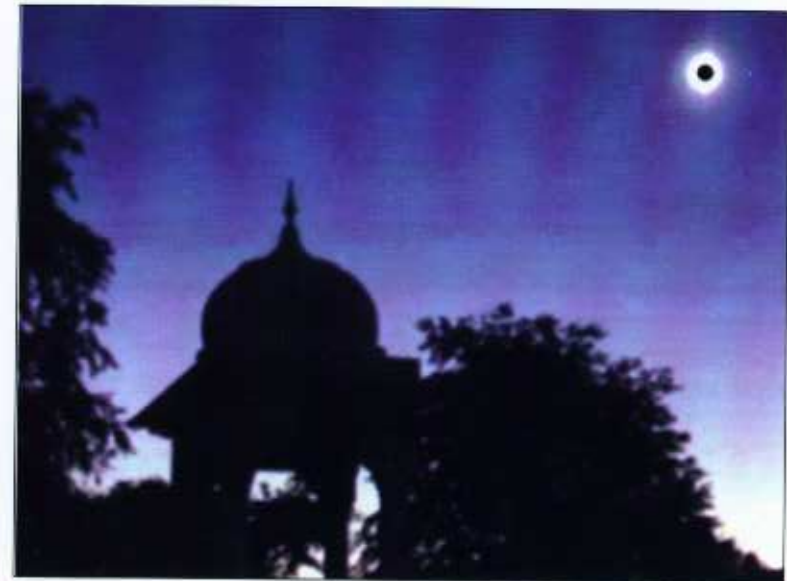


Plate 1b: During a total solar eclipse, when the Sun is fully covered by the Moon, the day suddenly turns into night.



Plate II: The Indian astronomer Aryabhata. (Sculpture in the courtyard of Inter-University Centre for Astronomy and Astrophysics, Pune.)



Plate III: Isaac Newton, who first explained why the planets moved.



Plate IV: The Sun god at the Konark Sun Temple in Orissa.



Plate V: Babylonian boundary-stone (about 1125-1104 BC) showing bas relief of astronomical motifs like the scorpion.

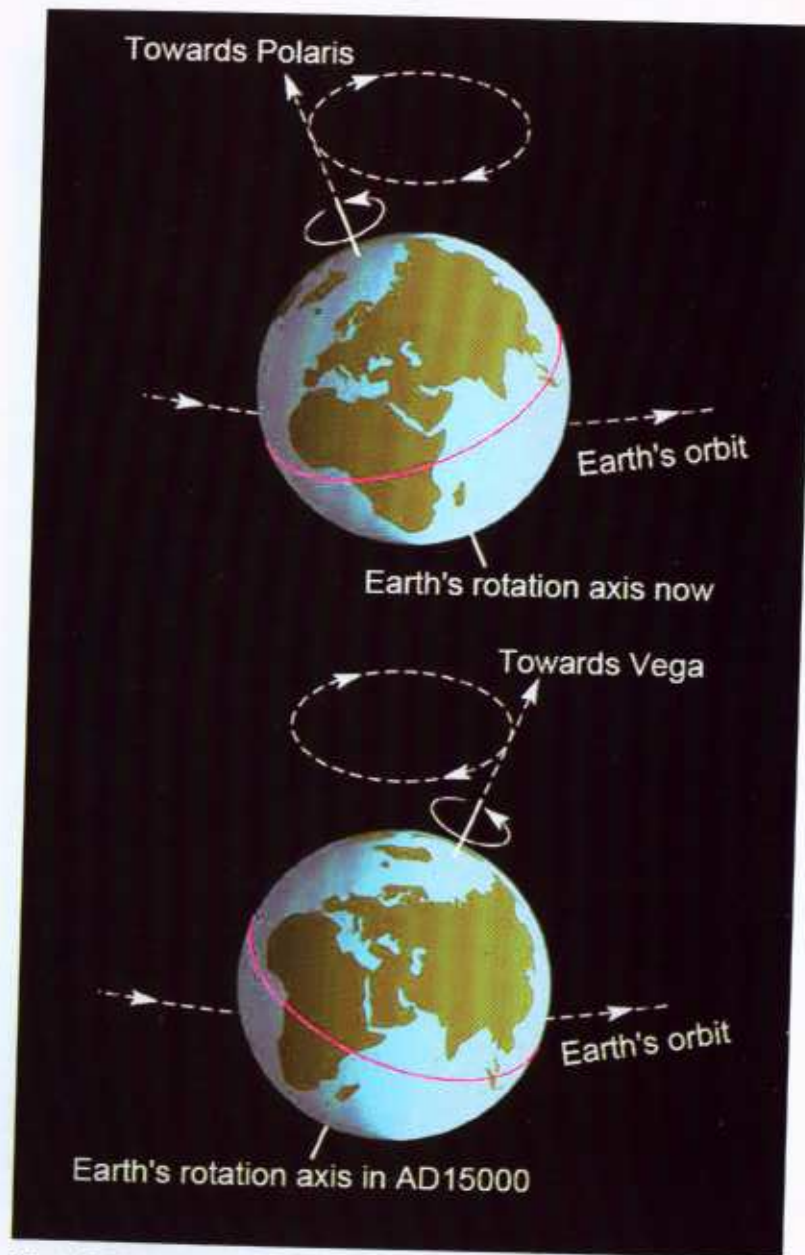


Plate VI: Due to the slow wobbling of the Earth's spin axis, Polaris will cease to be the Pole Star after a few thousand years and Vega will become the Pole Star in AD 15,000.



Plate VII: The Ishango Bone is a 17,000-year-old piece of bone with notch marks that are believed represent a six-month lunar calendar in terms of Moon phases. (Royal Belgian Institute of Natural Sciences.)



Plate VIII: The Hale-Bopp comet was one of the brightest comets seen during the 20th century.

The Origins of Astrology

In its traditional form, astrology is a type of divination based on the theory that the positions and movements of celestial bodies (Sun, Moon, stars and planets) at the time of birth profoundly influence a person's life. To all astrologers and astronomers before AD 17th century the terms 'astrology' and 'astronomy' were often used interchangeably, although sometimes the emphasis applied to each was different. Astronomy was considered more mathematical whereas astrology was more philosophical. In general, the practitioner of one was thought to also be a practitioner of the other. Thus the two share a common origin, sometime before the advent of recorded history in the 3rd and 4th millennia BC.

To our ancestors it was imperative to know when flood and drought, heat and cold were due, so that migrations might take place, and crops might be planted. All these activities could be regulated with reference to the stars, and were so, in countries such as ancient Egypt. Evidence of the recording of lunar phases has been revealed by notches carved on a piece of animal bone known as the Ishango Bone (*Plate VII*), dating back to about 15,000 BC, during the Old Stone Age, and before the development of agriculture. Such recording would have become far more important as a result of the development of agriculture between 10,000 BC and 5,000 BC, and evidence from many early cultures shows that the heliacal rising of the stars was used by 2,000 BC to give a more precise timing to the agricultural year.

The Egyptians, for example, after thousands of years of observations, knew that the early morning rising of the bright star Sirius was always followed by the flooding of the River Nile. It was important for Egypt's agricultural economy, and hence to the lives of the entire populations of the Nile valley, to know in advance about the floods because the rushing waters brought in rich fertile soil as silt, which helped Egyptian farmers to grow bumper crops.

Such pragmatic reasons were not the sole ones behind the development of astrology, the history of which is also intertwined with the history of religion. At the same time as practical correlations were made between such events as the Sun's annual movement across the sky and the seasons; symbolic connections were made between events which were not so obviously linked. The human pattern of life, moving from birth to death, was equated with the daily movement of the Sun in the sky, bringing with it the transition from darkness to light, and the annual cycle of vegetation throughout the seasons. Thus the observance of the calendar became, as it still is, an object of religious rituals, and there was a measure of interchange between heavenly sky deities and Earth-bound vegetation deities.

In India, Vedic priests used the knowledge of the motions of the Sun and Moon in the sky to plan sacrificial rites, which were an essential part of Vedic life. Knowledge of the stars was thus intimately connected with the daily life of ancient civilizations. Even today, festival dates in many countries including India are determined by the transit of the Sun from one constellation to another and the phases of the Moon. But that in no way implies that the Sun, Moon, stars or the planets are endowed with divine powers to influence human destiny. If the rising of Sirius before dawn heralded the flooding of the Nile it was not because of any divine power, but only because the dawn rising of the Sirius

coincided with the rainy season upstream of the Nile that brought flood in the river. Similarly, visibility of certain constellations may coincide with particular seasons—perfectly natural phenomena—that favoured sowing of crops, and so on.

Carl Sagan, the well-known American astronomer and planetary scientist, writes in his bestseller *Cosmos*:

As ages passed, people learned from their ancestors. The more accurately you knew the position and movements of the Sun and Moon and stars, the more reliably you could predict when to hunt, when to sow and reap, and when to gather the tribes. As precision of measurement improved, records had to be kept, so astronomy encouraged observation and mathematics and the development of writing.

Product of Human Ignorance

But in course of time, mysticism and superstition came into what had been largely an empirical science. It would not be an overstatement to say that astrology is a product of human ignorance and fear. People who lived 3,000 years ago were excellent sky watchers, but they could not explain everything they observed. They were unable explain the regular change of the pattern of stars in the night sky, the changing phases of the Moon, and the apparently erratic motion of certain star-like objects in the night sky. They were also at a loss to explain the sudden appearance of comets—the strange-looking 'stars with tail' that seemed to appear from nowhere (Plate VIII).

It is quite possible that these early people also found that some events in their life appeared to be linked with the appearance of some constellation or the position of some of the 'star-like' objects that appeared to move erratically and led them to believe that the position of the celestial bodies had an influence on their life. But that was several thousand

years ago, when human knowledge of the universe was limited to naked-eye observation.

Originally, astrologers presupposed a geocentric universe in which the 'planets' (including the Sun and Moon) revolve in orbits whose centres are at—or near—the centre of the Earth, and in which the stars are fixed upon a sphere with a finite radius whose centre is also the centre of the Earth. Special relations were believed to exist between particular celestial bodies and their varied motions and configurations with each other. These ideas no longer hold true.

Astrology is not Vedic

As we have seen in Chapter 3, among the earliest practitioners of astronomy were the Vedic people who lived in India about 3,500 years ago. Many proponents of astrology in India take pride in claiming that astrology has its origins in the Vedas. But the truth is something else.

The renowned Indian theoretical astrophysicist Prof. Jayant V. Narlikar writes in *The Scientific Edge*:

One should be very wary of anything declared to be Vedic or of ancient origin. Since India had an oral tradition of transmission of knowledge, very few reliable records of this ancient epoch are extant. The situation is thus different from that prevailing in other cultures like China, Arabia or medieval Europe where written traditions existed. What written works we have may well contain the *prakshipta* (later additions to a manuscript).

According to Prof. Narlikar, we have to look at the claim of Vedic astrology keeping in view the above facts. He further adds:

A survey of Vedic literature fails to reveal instances of nine 'planets' and their supposed influence on human destiny. There are references to omens and also to sacrifices to be performed at different times of the year as determined by

the positions of constellations. The seven-day week came to India from the Greeks through the Arabs.

Regarding the concept of the occult influence of the planets, Prof. Narlikar is of the opinion that it is of European origin:

... as indicated by a shloka from the *Surya Siddhanta* in which *Surya* (the Sun god) is telling the *asura Maya* 'to go to Rome [which was symbolic of Greco-Roman culture], your own city, where, because of a curse of Brahma, I will reveal to you this knowledge in the guise of a *Yavana*' [the name given to a foreigner or non-Indian often applied to a Greek].

Initially, astrology probably developed as a means to predict the fates of dynasties, empires and nations and was practised only in royal courts. But soon the notion of personal astrology developed in Alexandrian Egypt and spread through the Greek and Roman worlds about 2,000 years ago from where it came to India.

In fact, Greek astrology was transmitted to India in AD 2nd and 3rd centuries by means of several Sanskrit translations, of which the one best known is that done around AD 149 by Yavaneshvara and versified as the *Yavanajataka* by Sphujidhvaja, in about AD 270. The techniques of Indian astrology are thus not surprisingly similar to those of its Greek counterpart. But the Indians modified the predictions, originally intended to be applied to Greek and Roman society, so that they would be meaningful to the Indian situation. In particular, they took into account the caste system, the doctrine of metempsychosis (transmigration of souls), the Indian theory of five elements (earth, water, air, fire, and space), and the Indian systems of values. Thus astrology as practised in India is basically derived from Greek astrology. "It is, therefore, all the more ridiculous that by calling astrology *Vedic* we

are laying claims to an imported superstition," says Prof. Narlikar.

The Indians not only adopted Greek astrology but also made it more elaborate by adding as significant elements: the *nakshatras* (or lunar mansions); an elaborate system of three categories of *yogas* (or planetary combinations); and dozens of different varieties of *dashas* (periods of the planets) and *antardashas* (sub-periods). The number of subdivisions of the zodiacal signs was increased by the addition of the *horas* (15° each), the *saptamshas* ($4\frac{2}{7}^\circ$ each), and the *navamshas* ($3\frac{3}{9}^\circ$ each). They also increased the number of planets by adding the Sun, Moon and also the nodes of the Moon (*Rahu* and *Ketu*, the points of intersection of the lunar orbit with the ecliptic). Thus the *navagraha* (nine planets) of Indian astrology included the five visible planets—Mercury, Venus, Mars, Jupiter and Saturn—and the Sun, Moon, *Rahu* and *Ketu*. But all these complexities did not in any way imply that astrology practised in India is any more scientific or accurate than the system of astrology practised in the West, as often claimed by Indian proponents. This is because the basic premise that planets—which are nothing but simple rocky bodies—can influence human fate is flawed.

Quoting Carl Sagan again:

Astrology contends that which constellation the planets are in at the moment of birth profoundly influences your future. A few thousand years ago, the idea developed that the motions of the planets determined the fates of the kings, dynasties, empires. Astrologers studied the motions of the planets and asked themselves what happened the last time that, say, Venus was rising in the constellation of the Goat; perhaps something similar would happen this time. It was a subtle and risky business. Astrologers came to be employed only by the State. In many countries it was a capital offence for anyone but the official astrologer to read the portents in the skies: a good way to overthrow a regime was to predict its downfall. Chinese court astrologers who

made inaccurate predictions were executed. Others simply doctored the records so that afterwards they were in perfect conformity with events. Astrology developed into a strange combination of observations, mathematics and careful record-keeping with fuzzy thinking and pious fraud.

Modern Astrology

Modern popular astrology can be traced back to Claudius Ptolemaeus, popularly known as Ptolemy, who worked in the Library of Alexandria in AD 2nd century. As an astronomer, Ptolemy named the stars, listed their brightnesses, set down rules for predicting eclipses and, perhaps, also tried to understand why planets exhibit that strange, wandering motion against the background of distant constellations. Surprisingly, it was Ptolemy himself who introduced the concepts like planets ascendant in this or solar or lunar 'houses', etc., and believed that the planets and stars influenced not only behaviour patterns but also stature, complexion, and even congenital physical abnormalities.

Modern astrologers remember Ptolemy as the author of one of the oldest complete manuals on astrology—the *Tetrabiblos* (Greek) or *Quadrapartitium* (Latin); meaning 'Four Books'. The *Tetrabiblos* is said to have offered a detailed explanation of the philosophical framework of astrology, enabling its practitioners to answer critics on scientific as well as religious grounds.

Most of Ptolemy's philosophy rests upon the belief that planetary influences are derived from the planets' relationship with the Sun (the source of heat and light) and the Earth (the source of moisture). In this way the Moon is regarded as a 'cool and moist' planet because it lacks the warmth of the Sun and lies in the proximity of the Earth. Saturn is 'cold and dry' because it is furthest from the warmth of the Sun and, again, from the moisture of the Earth.

Ptolemy defined planetary characteristics by these humoral temperaments where, as in nature, warmth and moisture promote health and vitality whilst cold and dryness are conducive to decay. Hence Saturn became the principal agent of destruction and death; the 'greater malefic'. However, the fallacy of such arguments in the background of what we know of the planets today does not need elaboration.

Indian (Hindu) Astrology

As we have seen, practitioners of astrology in India often claim their system to be different and superior to the system followed by their counterparts in the West. The first, most important difference, they claim, is that the two systems use different zodiacs. The sidereal zodiac followed in India is the actual, observable, sequence of zodiacal signs based on the fixed pattern of stars that we see from Earth. Western astrology uses the tropical zodiac which has the same sequence of signs; but instead of being based on the fixed, observable pattern of stars, the tropical zodiac is figured from the location of the Sun when it crosses the Vernal Equinox (around March 22), which is the midpoint of the extremes of the Sun's apparent (as seen from the Earth) movement in the sky from north to south during the year. In other words, for the Western astrologer, the Sun's position on the 'first day of spring' designates the beginning of the zodiac's first sign, Aries, which is no longer the case because of the precession of the Earth's axis.

The next important distinction between the two systems of astrology is that whereas Western astrology regards the Sun and its position as the primary factor for interpretation, in the Indian system of astrology the rising zodiacal constellation is considered the primary significant factor. Instead of saying that everyone born within a 30 day or so period shares the same characteristics by having the same 'Sun sign', Indian astrology lays more emphasis on the

zodiacal constellation on the eastern horizon at the moment of birth and the position of the Moon in the zodiac.

Astrological 'Houses'

For casting a horoscope, astrologers use a system of twelve 'houses'. An astrological house is supposed to begin from the ascendant—the zodiacal constellation rising on the eastern horizon at the time of birth. To cast the horoscope an astrologer has to know which zodiacal constellation was rising at the particular moment at a particular place. If, for example, at the time of birth the constellation Leo was rising at the eastern horizon; then Leo will constitute the first house for the new-born, Virgo the second house, Libra the third house, Scorpio the fourth house, Sagittarius the fifth house, Capricorn the sixth house, Aquarius the seventh house, Pisces the eighth house, Aries the ninth house, Taurus the tenth house, Gemini the eleventh house, and Cancer the twelfth house. If the Sun were in Aquarius at that time, astrologers would say the Sun is in the seventh house. If Scorpio were rising at the time of birth, then Scorpio would be the first house, Sagittarius the second house, Capricorn the third house, Aquarius the fourth house and so on; and the Sun being in Aquarius would be in the fourth house in this case.

Another element that astrologers use in the construction of a horoscope are the 'aspects'—the angular separations between the planets, the ascendant, and the houses. In astrology it is assumed that the characteristic of the planets influence each other. An aspect between Mercury and Mars, for instance, is supposed to give "the intellectual capacities of Mercury a militant, active, sharp turn, because this agrees with astrological Mars." There are more complicated relations between the planets, their positions and their effects conjured up by astrologers and used in casting of horoscopes, which are almost impossible to establish or validate.

Arguments against Astrology

A large part of the population in any country is very familiar with astrological terms and expressions, but many even do not know the difference between *astronomy* and *astrology*, between an astronomer and an astrologer. One may feel that the suffix “-logy”, as in biology, psychology, or geology, perhaps grants astrology a scientific touch. But the fact is that astronomers make scientific studies of the universe; they study the stars and planets to learn about their composition and other characteristics. Astronomers are not concerned with the influence of stars and planets on human affairs on Earth, which lies in the domain of astrologers. Thus there is a clear distinction between astronomy and astrology and the two are not related, as many practitioners of astrology would like to make us believe.

Some astrologers claim that astrology is a science because it is based on empirical evidence: experience and observation. Astrologers also claim that according to traditional definitions of science, astrology is a scientific process because it is a discipline which uses set rules to explain natural phenomena. Also, the Greek word *scientia* simply means ‘wisdom’. Some astrologers claim that traditional astrology is a science, while others want to create a new scientific astrology separate from traditional practices. However, modern scientific method usually requires that theories be tested through experiments under controlled conditions.

Regular claims are made that some astrologer successfully predicted a striking event—an earthquake, an airplane crash, the death of a celebrity, and such things. But a look at the original predictions always brings out their vagueness. For example, an earthquake may have been predicted, but the place (“somewhere in the northern hemisphere”) and the time (“in the month of December”) were mentioned only in vague terms. The same is true for the other cases, which are of very general nature and are known to happen regularly somewhere on Earth. Quite often, the few correct predictions which appear impressive usually concern events that are not all that improbable. Thus, even if a prediction does come true it might be more a mere coincidence than anything else. Of course, there is no way of proving or disproving such coincidences, as they fall beyond the scope of scientific method.

Astrology can be termed as “a vision of man and his relation to the universe.” This vision assumes that there exists a connection between the two, and that the nature of this relationship is such that individual human characteristics “are determined by the state of the universe”, which in practice is limited to the Sun, Moon, the planets and the zodiacal constellations. There are supposed to be moments—the moment of birth—when a “one-way traffic from the universe is supposed to imprint a lasting mark on the newborn, a mark that is decisive for his character, the main lines of the course of his life, and so on.” No astrologer can, however, explain how such imprinting takes place.

Even though astrology has been practised for hundreds of years, there is still no place for astrology at accredited academies and scientific institutions. Astrologers have been making predictions about upcoming events in the world, about the winning prospects of politicians, and even about natural disasters, but one does not find them in centres for policy study or defence or intelligence services, or in

meteorological services. Although politicians are known to rely heavily on astrologers, how often they succeed is open to question. The fact is that astrology does not have any official standing or recognition, no matter how popular it appears to be; popularity does not give it credibility.

In 1975, a group of 186 leading scientists in the West signed a circular denouncing the very basis of astrology, which was published in the journal *The Humanist*. Here are a few excerpts from the circular:

It is simply a mistake to imagine that the forces exerted by stars and planets at the moment of birth can in any way shape our futures. Neither is it true that the position of distant heavenly bodies make certain days or periods more favourable to particular kinds of action, or that the sign under which one was born determines one's compatibility, or incompatibility with other people.

One would imagine, in this day of widespread enlightenment and education, that it would be unnecessary to debunk beliefs based on magic and superstition. Yet, acceptance of astrology pervades modern society. We are especially disturbed by the continued uncritical dissemination of astrological charts, forecasts, and horoscopes by the media and by otherwise reputable newspapers, magazines, and book publishers. This can only contribute to the growth of irrationalism and obscurantism. We believe that the time has come to challenge directly, and forcefully, the pretentious claims of astrological charlatans.

There are organisations which have taken up cudgels against astrology. Among them is the New York-based group called the Committee for Skeptical Inquiry (CSI). Its origins lie in the above circular. The CSI encourages the critical investigation of paranormal and fringe-science claims from a responsible, scientific point of view and disseminates

factual information about the results of such inquiries to the scientific community and the public. It also promotes science and scientific inquiry, critical thinking, science education, and the use of reason in examining important issues.

The main argument against astrology is that there is hardly any rationale for the assumptions it makes to cast horoscopes and make predictions. Advocates of astrology cannot account for the underlying basis of astrological associations with terrestrial affairs, have no plausible explanation for its claims, and have not contributed anything of cognitive value to any field of the social sciences.

Defenders of astrology often try to mislead the gullible by citing irrelevant examples like "the length of a woman's menstrual cycle corresponds roughly to the lunar cycle", or "the tides in Earth's oceans are caused by gravitational fields of the Sun and Moon". They forget that the similarity between the length of the human female menstrual cycle and the lunar cycle is purely coincidental; one is not dependent on the other and neither can affect the other. And it is mainly the Moon's (and to some extent the Sun's) gravitational pull that causes the tides. Here the question arises: What effect could Moon's gravitational pull have on a human being considering that in the human body water is present only in the cells and not as a single large entity like in the oceans?

The renowned British cosmologist Stephen Hawking provides a more convincing argument against astrology in his book *The Universe in a Nutshell*:

The human race has always wanted to control the future, or at least to predict what will happen. That is why astrology is so popular. Astrology claims that events on Earth are related to the motions of the planets across the sky. This is a scientifically testable hypothesis, or would be if astrologers stuck their neck out and made definite predictions that could be tested. However wisely enough,

they make their forecasts so vague that they can apply to any outcome. Statements such as 'personal relations may become intense' or 'you will have a financially rewarding opportunity' can never be proved wrong.

But the real reason most scientists don't believe in astrology is not scientific evidence or the lack of it but because it is not consistent with other theories that have been tested by experiment. When Copernicus and Galileo discovered that the planets orbit the Sun rather than the Earth and Newton discovered the laws that govern their motion, astrology became extremely implausible. Why should the positions of other planets against the background sky as seen from Earth have any correlations with the macromolecules on a minor planet that call themselves intelligent life? Yet this is what astrology would have us believe.

Astrology is Static

There is another reason why astrology does not qualify as a science. Science as we know it, is not static. Scientific concepts have undergone sea change as newer facts and experimental observations have come to light. A scientific theory, however long-standing, is discarded without hesitation if experimental evidence proves it to be wrong. Scientific research is basically a process of refinement of existing knowledge through careful experimentation and observation. Often, even long-accepted concepts have had to suffer ignominious death in the face of newfound evidence. The Earth-centred concept of the universe held sway for several millennia, strongly supported by the Church. But it was swept aside when compelling evidence in support of a Sun-centred planetary system started piling up and the Polish astronomer Nicolaus Copernicus finally came out with his model of the Sun in the middle with the planets going round.

In contrast, the basics of astrological prediction have

remained static for thousands of years, without assimilating the newfound knowledge. One needs to remember that any body of knowledge—including astrology, is a collection of only contemporary knowledge. About 3,000 years ago, when the practice of astrology may have started, the scientific knowledge about the Sun, Moon, stars and planets, except probably their apparent motions in the sky, was non-existent. It was not known how big or how far the stars and the planets were, what they were made of, and how they moved in space. Although the concept of an Earth-centred solar system was discarded more than 460 years ago, astrologers still follow the geocentric concept; otherwise why is no allowance made for the enormous change in distances that occur between the Earth and the planets as they orbit the Sun?

The hypothesis of astrologers that planetary forces are transmitted to Earth without attenuation with increasing distance, and do not vary with respect to the differences in masses of the Sun, Moon and planets on which they originate, is totally inconsistent with the laws of physics. In fact, the distances of the planets from Earth vary widely as they go round the Sun. For example, when Mars is nearest to the Earth its distance is only about 56 million kilometres, but when farthest the distance increases to more than 378 million kilometres; that is, 6.75 times farther (*Fig. 26*). Similarly, the distance of Jupiter from Earth varies between 600 million and 928 million kilometres. And, as any student of science knows, even if we consider the gravitational effect (our present knowledge of physics does not allow for any other known effect) of the planets on Earth—however miniscule—should show a variation according to the inverse square law; that is, the effect should decrease with the square of distance between the two bodies. So if Mars has any effect on Earth—and it can be only gravitational, as there is no evidence otherwise—it would become weaker by a factor

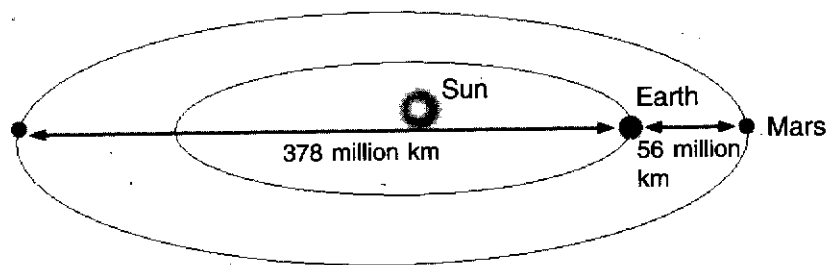


Fig. 26: As the planets go round the Sun, their distance from Earth varies widely. In case of Mars it ranges between 56 million and 378 million kilometres.

of about $(6.75)^2$; that is, by almost 45 times when it is farthest from Earth than when nearest. But astrology does not seem to take such a vital factor into account. In astrology, only the position of a planet in the background of a constellation is considered important and not its distance from Earth, which is scientifically inconsistent.

Again, astrologers tend to make too much of the 'retrograde' motion of some planets, which is nothing but an illusion created by the different orbital speeds of the planets compared to Earth's, as we have seen in Chapter 2.

Thanks to modern advances in science and technology, mysteries of the natural world no more bewilder us. Today we have scientific explanations for most of the natural phenomena, be it solar and lunar eclipses or earthquakes or sighting of a comet. Rising of the Sun, Moon and the stars, and the apparent movement of the planets against the background of stars in the sky are all natural phenomena that are highly predictable. But there is no scientific or logical basis to assume that these phenomena can be related to individual human fate, as astrologers would make us to believe. Even the so-called use of computers for horoscope calculation does not endow astrology with any scientific legitimacy; it is only aimed at misleading the gullible public.

A Pseudoscience

Astrology is often described as pseudoscience by scientists. A pseudoscience is an established body of knowledge which masquerades as science in an attempt to claim a legitimacy which it would not otherwise be able to achieve on its own terms. The most important of its defects is the lack of the carefully controlled and thoughtfully interpreted experiments which provide the foundation of the natural sciences and which contribute to their advancement.

The term "established body of knowledge" is important here, because the pursuit of scientific knowledge usually involves elements of intuition and guesswork; experiments do not always test a theory adequately, and experimental results can be incorrectly interpreted or even wrong. In legitimate science, however, these problems tend to be 'self-correcting', if not by the original researchers themselves, then through the critical scrutiny of the greater scientific community.

There have been several well-documented instances in which the correction process referred to above was delayed until after the initial incorrect interpretation became widely publicised, resulting in what has been called 'pathological science'. A few of the best known of these incidents are the "discoveries" of N-rays, of polywater, and of cold fusion. All of these could have been averted if the researchers had not been so enthused with their results that they publicised them before they had received proper review by others. Human nature being what it is there is always some danger of this happening. To discourage it, most of the prestigious scientific journals will refuse to accept reports of noteworthy work that has already been made public.

Thus astrology, not being based upon collected data and carefully controlled, objective observations, is not a scientific discipline. Astrology does not make falsifiable predictions which can be tested and re-tested by independent observers

and researchers. Astrology has not discovered any celestial object—indeed, there is nothing to show that astrology has discovered or even predicted the appearance of a comet, for example, although it claims to reveal the future of individuals and nations. On the other hand, if a new comet is sighted or when there is a transit of Venus or Mercury, or when Mars or Jupiter comes near Earth in their orbit—all explainable natural phenomena—astrologers waste no time in spreading baseless scare among the public through the media.

Planets Exerting Influence?

The mainstay of astrological 'calculations' is the so-called interaction of the planets (the Sun, Moon and the fictional *Rahu* and *Ketu* included) with individuals depending on the individual's natal chart or horoscope. Astrology also differentiates between the 'influences' of the planets on the basis of their position in the sky. If we have to accept this scheme of things then the first question that arises is: In what manner do the planets interact with or exert their influence on individuals?

From our present knowledge of the planets, on the basis of scientific data and images sent back by space probes, we know that the planets are made up of the same elements as our Earth although the composition of each planet differs. We also know that the only interaction the planets can have with objects on Earth, including human beings, is gravitational.

Gravitation, which is defined as the force of mutual attraction between all bodies, can be called "the cosmic force" par excellence. It is the only force that plays a crucial role on the scale of the universe although by its nature it is an exceptionally weak force. Only celestial bodies contain enough matter to make gravitation work in a noticeable manner. The relatively enormous mass of Earth attracts us

and causes what we call 'weight'.

Although a planet may be very massive and have a very strong gravitational field, its effect at a distance may be negligible. For instance, our nearest star, the Sun, has a mass 332,000 times the mass of the Earth, but we hardly notice its attraction. This is because gravitational attraction weakens inversely as the square of the distance between the interacting bodies. So, the gravitational effect of the planets on anything on Earth, including humans, would be almost imperceptible when compared with the effect of Earth's gravitation. For a baby born on Earth, the nurse-midwife in the maternity ward exerts a gravitational pull more than a thousand times stronger than that of the Moon and many billion times stronger than that of the distant planets. The gravitational influence of the Moon and the planets on the baby at the time of birth would thus be almost imperceptible compared to the gravitational effects of its earthly surroundings!

True, some of the giant planets like Jupiter and Saturn are known to give off some electromagnetic radiation, but at the distance at which they are, the effect of such radiation on humans on Earth would be millions or billions of times weaker than the effect of the electromagnetic radiation given off by electrical and electronic gadgets like mobile phones and the radio and television signals received in our homes. Thus, on the basis of simple laws of physics, we can say with confidence that planets cannot have any measurable influence on humans on Earth.

The next question is, even if for a moment we accept that planets do have some influence, however miniscule, how can that influence be selective only for certain individuals, and how can it decide future events in the life of the individual, as astrologers claim? What change could gravitational effect bring about in the genes at the time of birth of an individual to decide his or her personality or

fate? There is no known mechanism by which the planetary positions at the time of birth can influence the genetic make-up of an individual, which is decided long before birth at the time of fertilisation of the female egg by male sperm. Neither is there any plausible means by which the gravitational effect of planets can be linked to the fate of an individual, which is a sum total of several internal and external factors (nature and nurture). On the other hand, advances in genetics have shown that genes do decide many of the human traits and frailties such as temperament and proneness to certain diseases. So it is not the planets but genes that may be said to control our fate to some extent.

Irrelevant Examples

Proponents of astrology often try to mislead the gullible by citing irrelevant examples where science also purportedly goes wrong. Here is an example from an article on a website that defends astrology as a science:

A man falls sick due to some disease. He goes to his neighbourhood doctor. The doctor advises him to go for some tests. After seeing the results of those tests and considering the patient's symptoms, the doctor concludes that the man has contracted some particular disease. He prescribes some medicines and the patient goes home in the hope of getting rid of the sickness as soon as possible. After taking the medicines for next two days, the patient finds that the medicines are not working the way they were supposed to work. He goes back to the doctor and the doctor changes the medicines and the person starts responding to the second set of medication immediately. Within a few days, the person is back to his old healthy self. What would have happened if the person had not responded to that second set of medicines? Most probably he would have gone to another doctor. That doctor would have advised him to go for more tests, diagnosed his problem as per his own knowledge and experience and

treated him accordingly. Again, there would have been the same probability of the patient getting rid of his disease.

So, in the end it boils down to problem of correct diagnosis. As soon as the disease is identified correctly, it can be treated successfully. The doctor's problem is to identify the disease correctly, given the symptoms and the results of the tests conducted. In fact, he guesses the disease based on the symptoms the patient displays and to confirm his suspicions the doctor asks the patient to undergo a particular set of tests. If the doctor's first guess is proved wrong, he suggests another set of tests to the patient aimed at confirming his second best guess of the disease.

There is one more element which may mar the chances of the patient getting better: The test results. If the lab conducting those tests makes a mistake, the doctor is bound to be misled by the results. It has also been observed many a times that even with the same symptoms and the same set of test results, different doctors may diagnose the problem differently.

The problem with the above example is that even if a patient does not respond to a medicine there may be adequate reasons for that, like antibiotic resistance or effect of some other drug, both of which may be strictly scientific and testable. Here it is not the question of whether a medicine acts or not but whether a correct scientific method is being followed. On the same count, even if an astrological prediction turns out to be correct it does not give scientific credibility to astrology because the method of astrology depends more on obscurantist assumptions which are unscientific and unverifiable.

The Ruling Planets

Astrologers tell us that each one of the 12 zodiac signs is ruled by one of the planets. They use such expressions as "Aries or *Mesha* is ruled by Mars", or "Gemini or *Mithuna* is

ruled by Mercury", "Sagittarius or *Dhanu* is ruled by Jupiter", and so on. As any astronomer would know, the planets are members of our Solar System which extends up to a distance of about 6,000 million kilometres from the Sun, while the nearest star (other than the Sun) is at a distance of about 4.3 light years; that is, more than 40 million million (40×10^{12}) kilometres away, which is almost 7,000 million times farther than the outermost planet. Most of the other stars are hundreds or thousands of times still farther away. Now the question is, how can a planet 'rule' over a constellation lying in space so far away? Obviously, such statements carry no meaning except some vague assertions that can never be demonstrated or verified.

Relevance of Birth Time

Astrologers' penchant for the exact time of birth becomes irrelevant in view of the fact that today the time of birth can be selectively decided by parents and doctors, as happens in most caesarean cases. If the time of birth were so crucial in deciding the fate of an individual, every mother would like to deliver a super baby just by choosing the astrologically most propitious time of delivery. But the pertinent question here is: Why are the initial conditions more important than all subsequent conditions of upbringing for one's personality and traits? Why is the moment of birth chosen as the significant moment rather than the moment of conception? Does it mean that the mother's womb can effectively shield the unborn baby from the influence of the cosmic bodies and the concrete building of the delivery room cannot?

Another moot point is: What really marks the time of birth? As any mother would know, it is rare that the birth of a baby takes place instantly; there is no single moment to mark the time when a baby is born. Is it the moment the water breaks? The moment when the first hair or toenail

peeks through? When the last toenail or hair passes the last millimetre of the birth canal? When the umbilical cord is cut? When the baby takes the first breath and lets out a cry? Or does birth occur at the moment a physician or nurse looks at a clock to note the time of birth? And how does one determine the time of birth in case of a caesarean delivery? Astrologers are unable to provide satisfactory answers to these simple questions.

Horoscopes and Marriage

In India thousands of young girls are denied marriage because their horoscopes do not match with those of the prospective grooms. Commenting on this unscientific practice Prof. Narlikar says:

Statistical studies have demonstrated that there is no correlation between matching birth charts of couples and the quality of their married life. Yet the practice of matching birth charts before arranging marriages is very common, even among the highly educated and sophisticated strata of our society. When there is neither a scientific reason nor even empirical evidence for the effects of planets on human lives, important decisions ranging from forming ministries to moving into a new house, buying a car or starting a new business are taken with deference to the so-called auspicious or inauspicious times.

Perhaps the most apt answer to the question whether astrology works was provided by the former President, Dr. A.P.J. Abdul Kalam, after he was elected to the post in 2002. When asked by the late Pramod Mahajan whether he had any auspicious date in mind for his swearing-in, Dr. Kalam is said to have replied, "Days and nights are formed by the rotation of the Earth on its axis. So long as the Earth rotates, 365 days a year and seven days a week are auspicious for me."

Astrology as Part of Science Curriculum

Some years ago there was a move by the University Grants Commission (UGC) to introduce astrology as a science subject in Indian universities, which was vehemently opposed by the country's scientific community. More than 100 scientists and 300 political and social scientists wrote in protest to the then Indian government denouncing the move. Critics opposed the proposal on various grounds. Some felt that topics like astrology represent a 'backward-looking rejection of orthodox sciences'. The courses were proposed to be introduced at graduate and postgraduate level, with provision made for research at Ph.D. level. It was claimed that over 90 per cent of the Indian population, scientists included, believe in astrology and so there was nothing wrong in introducing its study in universities.

The issue here is not whether astrology could be a part of university curriculum. While it may be appropriate to study the historical and cultural significance of astrology as an academic exercise, a course on astrology has no place in a university's science curriculum simply because astrology does not qualify as a science. Fortunately, the move to introduce astrology as a science subject in Indian universities was finally dropped.

7

Testing Astrology

There have been few real experiments conducted in astrology and the results are mixed—some are positive, others negative. Many experiments are badly designed or damaged by bias, including some which produce negative results and others which produce positive ones. Some astrologers think it should be possible to 'prove' astrology experimentally, but others argue that no two people have the same horoscope and that we are all unique, so it is a mistake to imagine that we can gather large numbers of horoscopes together and test astrology's validity statistically. Others say that the astrological process exists only while the astrologer is reading a horoscope, and that artificial experimental conditions cannot hope to capture the magic of the moment.

The results of 'tests' of astrology have always been disputed. Those with positive results (confirming the astrologers' thesis) have been largely dismissed by scientists on the grounds of technique, while those with negative results (disputing the astrologers' thesis) have been largely dismissed by astrologers on the grounds that they fail to test what the astrologers consider to be essential aspects of their work. The main complaint of astrologers has been that most scientific tests have tested the scientist's concept of astrology, not astrology as practised by the 'reputable' astrological community.

French psychologist and statistician Michel Gauquelin devoted much of his life trying to determine whether astrology has any scientific validity. He found little or no evidence of the zodiac signs being of importance, especially between family members. He found that very few people showed the typical traits associated with their Sun sign and rather that they lacked in them. Of all the many analyses performed by him, all failed to conclude that astrology had any such validity, except his controversial concept of 'Mars Effect' published in his book *The Influence of the Stars* (1955). In it he stated that Mars occupies certain positions in the sky more often at the birth of sports champions than at the birth of ordinary people. Of course, it immediately became the subject of considerable controversy. In fact, such was the controversy that Gauquelin took his own life in 1991, having previously destroyed his magnificent work and original data.

Yet before his death, in his book *The Scientific Basis for Astrology* (1970), Gauquelin wrote:

It is now quite certain that the signs in the sky which presided over our births have no power whatever to decide our fates, to affect our hereditary characteristics, or to play any part, however humble, in the totality of effects, random or otherwise, which form the fabric of our lives and mould our impulses to action.

In the mid-1980s, an American physicist Shawn Carlson of the University of California, Berkeley, USA did a study to find out the scientific validity of astrology using two double-blind tests of the thesis that astrological 'natal charts' could be used to describe personality traits of subjects accurately. The results, published in the journal *Nature* (5 December 1985), were revealing.

Carlson used an innovative method to avoid the earlier criticisms by designing an experiment that could meet the

tight specifications of both the scientific and astrological communities. The experiment was designed with the help of scientists, statisticians and astrologers. It was meant to test the 'fundamental thesis of natal astrology'—the proposition that:

The position of the 'planets' (all planets, the Sun and Moon, besides other objects defined by astrologers) at the moment of birth can be used to determine the subject's general personality traits and tendencies in temperament and behaviour, and to indicate the major issues which the subject is likely to encounter.

In order to satisfy both scientific and astrological communities, people held in high esteem by their respective communities were chosen as advisers, and care was taken to eliminate all biases which could tend to 'randomise' the results and thus favour the scientific hypothesis over the astrological one. Similar care was taken to make sure that hidden clues were not available which could be used by astrologers or subjects to choose correct answers not based on astrological information alone. An important difference between this and many previous tests was the extensive use of double-blind techniques. (A double-blind test is a control group test where neither the evaluator nor the subject knows which items are controls. The purpose of controls and double-blind testing is to reduce error, self-deception and bias.)

The experiment thus designed consisted of two parts. In one set, volunteers provided information about their date, time and place of birth from which their natal charts were prepared by astrologers. Each volunteer then attempted to select his own natal chart interpretation from a group consisting of his own and two other interpretations chosen at random from the whole group. In the other set, the participating astrologers were separately given the natal

chart of a random subject and an objective measure of personality traits called the California Personality Inventory (CPI). (The CPI was developed over 40 years ago as a dynamic and objective measurement of personality and behaviour. It is a self-report personality inventory consisting of several hundred yes-no questions and yields scores on a number of scales including dominance and self acceptance, and self control and achievement, etc.) The astrologers were also given two other CPIs chosen at random from the group of all the volunteers' CPI test results. The astrologers were asked to select the CPI that described the personality closest to the personality indicated by the natal chart.

For both tests even if the correct choice was made randomly, according to simple law of probability (scientific hypothesis), they would be correct one-third of the time. The astrologers, on the other hand, predicted that the choice would be correct "at least half" of the time or more. However, analysis of the data showed that overall, the correct correlations totalled less than one-third, proving thereby the utter undependability of astrological forecasts. The author concluded:

We are now in a position to argue a surprisingly strong case against natal astrology as practised by reputable astrologers. Great pains were taken to insure that the experiment was unbiased and to make sure that astrology was given every reasonable chance to succeed. It failed.

Time Twins

Contrary to what astrologers would like us to believe, the personal horoscope is not all that unique. To cast a horoscope, an astrologer starts from a certain place and an exactly determined time. The requirement for these exact data may give the impression that a horoscope can only be connected to one person, but that is not the case.

Position of the objects in the sky changes very slowly.

Even the apparent rotation of the celestial dome—and therefore the changes in ascendant and houses—has a speed of only one degree in four minutes. So if we take one zodiacal constellation to span 30° , as astrologers take it, then the ascendant remains on the horizon for as long as 120 minutes; that is, two hours. Similarly, the planets also take a long time to move from one constellation to the next one. Mercury, the fastest moving planet in the sky, takes from 8 to 30 days depending on its position in the sky, to move across one zodiacal constellation. If we take the position of the Moon, here too, the motion is quite slow. The Moon moves about 12.5° eastward per day on average; that is, it takes more than two days to move across one zodiacal constellation.

For casting a horoscope an astrologer uses the date and time of birth for finding the positions of the planets in the zodiac as given in an astronomical ephemeris. As shown above, planets move across the zodiac quite slowly and that is why in an ephemeris the positions of the planets are given for each day or, for the outer planets, for every three or five days, usually at midnight Universal Time or GMT. Thus an astrologer has planetary data that varies over a period of at least one day or 24 hours. For a lesser period the planetary position would be at most guesswork.

Thus, theoretically, for all babies born within a span of two hours—the time it takes for one zodiacal constellation to fully clear the horizon—the ascendant and the planetary positions, and the position of the Moon would be practically the same for the reasons explained above. And so, for children born at the same place (in the same city, for example) within a time interval of a few minutes the horoscopes should not differ in any essential way. Such children are often termed as 'time twins'.

Time twins are surprisingly numerous. The spacing of human births in a large population is described by a Poisson distribution, which shows that every year in a city of one

million people, about 4,000 pairs of time twins are born 5 minutes apart or less. The number increases very rapidly as the city size or time interval increases. In a population of ten million the annual number of pairs is about 100,000, same as the number born 60 minutes apart or less in a population of one million.

Time twins thus could be the definitive test of astrology because errors or uncertainties of birth chart interpretation are avoided. There are many cases in which one twin is killed in childhood while the other lives to a prosperous old age despite their being born in precisely the same place within minutes of each other.

A study was carried out by Geoffrey Dean, a scientist and former astrologer based in Perth, Australia, and Ivan Kelly, a psychologist at the University of Saskatchewan, Canada. Data of more than 2,100 people—most of them born within minutes of each other—was tracked for several decades. The study involved more than 2,100 babies who were originally recruited as part of a medical survey begun in London in 1958 into how the circumstances of birth can affect future health. All the babies, born in early March that year, were registered and their development monitored at regular intervals. According to astrology, the time twins should have had very similar traits.

The researchers looked at more than 100 different characteristics, including occupation, anxiety levels, marital status, aggressiveness, sociability, IQ levels and ability in art, sport, mathematics and reading—all of which astrologers claim can be gauged from birth charts. The results of the study, reported in the *Journal of Consciousness Studies* (Vol. 10, No. 6-7, June-July 2003), gave no evidence of similarities between the time twins. According to the paper, "The test conditions could hardly have been more conducive to success. . . but the results are uniformly negative." As per Dr. Dean, the results undermined the claims of astrologers,

who typically work with birth data, which is, far less precise than that used in the study. "They sometimes argue that times of birth just a minute apart can make all the difference by altering what they call the 'house cusps'," he said. "But in their work, they are happy to take whatever time they can get from a client."

In other words, these studies conclusively proved that astrology has no scientific basis. In fact, not a single classical astrological element has been able to stand critical statistical research, although this kind of research is ideally suitable to establish astrology as a scientific discipline. Unfortunately, no study of this kind is known to have been attempted with the Indian system of astrology.

It is pertinent to mention here that astronomy is a predictable science which can be practised and enjoyed by anyone. It is criminal to allow it to be sullied by the preposterous claims of practitioners of obscurantism in the name of astrology.

Astrology and Gemstones

Gemstones are any of the various minerals highly prized for beauty, durability, and rarity. A few non-crystalline materials of organic origin (e.g., pearl, red coral, and amber) are also classified as gemstones. Gemstones have attracted humankind since ancient times, and have long been used for jewellery. The prime requisite for a gem is that it must be beautiful, which may be its colour (or lack of colour), iridescence, opalescence, asterism (the exhibition of a star-shaped figure in reflected light), and lustre. If the gemstone is to retain the polish applied to it and withstand the wear and tear of constant handling, it must also be durable.

Of the more than 2,000 identified natural minerals, fewer than 100 are used as gemstones and only 16 have achieved importance. These are beryl, chrysoberyl, corundum, diamond, feldspar, garnet, jade, lazurite, olivine, opal, quartz, spinel, topaz, tourmaline, turquoise, and zircon. Some of these minerals provide more than one type of gem; beryl, for example, provides emeralds and aquamarines, while corundum provides rubies and sapphire. In virtually all cases, the minerals have to be cut and polished for use in jewellery.

Gemstone Myths

Besides their use in jewellery, gemstones have also been closely associated with astrology and have been regarded by many civilizations as miraculous and endowed with

mysterious powers. Different stones are claimed to be endowed with different and sometimes overlapping attributes. Gemstones are being used increasingly for astrological purposes, as a remedy for a wide variety of human problems. For example, diamond is said to enhance the wearer with charm and beauty. It is claimed to strengthen the kidneys and reproductive organs, and also protect from severe diseases. The ancient Romans believed that diamond, when worn on the left arm, next to the skin, would give the wearer bravery and daring.

Ruby is another precious gem and can easily be the equal of a diamond in value. In India and China the ruby is worn to promote health and happiness. A power ascribed to the ruby both in the Orient and Europe was its ability to foretell danger by a sudden loss of colour and brilliance. Ruby is said to strengthen the heart, improve digestion, and promote circulation.

Blue sapphire is one of the earliest coloured gems known to man. It is said to clear infections and ward off all negative energies. It is said to be anti-tumour and anti-fat and good for reducing therapy and also capable of strengthening the bones, increasing longevity and helping calm the nerves and emotions.

Yellow sapphire is considered by many to be the most effective for promoting all-round health and well-being. It is said to give energy and vitality, and regulate the hormonal system.

Emerald has a great history, being held in high esteem by many cultures throughout history. Emeralds have been found in Egyptian and Etruscan archaeological sites. In India, emerald is believed to aid in enhancing memory. It is said to calm mental agitation, regulate the nervous system, help stop nerve pain, improve speech and develop intelligence.

Cat's-eye is considered good for promoting psychic and spiritual perception. It is said to be a good nerve stimulant

and helpful for mental disorders. In India, where it is highly valued, it is believed to bring the wearer material wealth.

Blood coral is said to be beneficial to the physical body. In India, China, and Japan, it is extensively used in Rosaries, and is very popular, being regarded as a sovereign remedy against cholera and all epidemics, and invaluable in indicating to its wearer the presence of poison, or the danger of illness, by changing colour. Red coral is said to strengthen the blood and reproductive system, improve energy and calm emotion, build flesh and muscle, give courage and improve work capacity.

Pearl is said to be good for promoting body fluids and the blood, nourishing the body tissues and the nerves. It is said to strengthen the female reproductive system, improve fertility, and calm the emotions.

However, to what extent the above beliefs are scientifically valid is open to question, although astrologers attach great importance to their mystical powers on humans, if worn correctly. None of the above-mentioned gemstones are known to emit any kind of mysterious 'rays' that may influence the physiology and help in improving health condition. Even with coloured gemstones, the effect of the transmitted colour would be at best localised to the patch of skin exposed to it. Here too, if it is only the colour then any transparent coloured material should be as effective if the transmitted wavelengths are the same.

What are Gemstones Really?

If we look at the composition of gemstones it will be difficult to understand why they should be endowed with any special powers, as claimed by astrologers. Basically a gemstone is the naturally occurring crystalline form of a mineral, which is desirable for its beauty, valuable in its rarity and durable enough to be enjoyed for generations. There are more than 40 popular gem varieties and many more rare gemstones.

Although some gemstone varieties have been treasured since prehistoric times and others were only discovered later; they are all nature's gifts to us. These gems are nothing more than simple minerals, born in hellish fires deep below Earth's surface.

Diamonds cannot form on the surface of the Earth; they are made from pure carbon under extreme pressure and temperature deep in the interior of the Earth. Diamond is actually unstable at the pressures we live in and ultimately would change to graphite—the 'lead' of lead pencils—the form of carbon that is most stable in our environment. Fortunately, the transition takes place at an infinitesimally slow pace; certainly not within our lifetimes. Besides being the hardest substance with exceptional brilliance because of a high refractive index, diamond has no other attributes to endow it with mysterious powers.

For thousands of years, the ruby has been considered one of the most valuable gemstones on Earth. It has everything a precious stone should have: magnificent colour, excellent hardness and outstanding brilliance. In addition to that, it is an extremely rare gemstone, especially in its finer qualities. For a long time India was regarded as the ruby's classical country of origin. In the major works of Indian literature, a rich store of knowledge about gemstones has been handed down over a period of more than two thousand years. The Sanskrit word for ruby is *ratnaraj*, which means something like 'king of the gemstones'. And it was a royal welcome indeed which used to be prepared for it. Whenever a particularly beautiful ruby crystal was found, the ruler sent high dignitaries out to meet the precious gemstone and welcome it in appropriate style. Today, rubies still decorate the insignia of many royal households.

Throughout history, rubies and sapphires have had their own separate folklore and attributes. But, astoundingly, they are actually the same mineral—and identical to black crystals

of emery or corundum, used as an abrasive in industry. The only difference lies in slight traces of impurities. Corundum is basically an oxide of aluminium, which is colourless in pure form. If the crystal contains traces of chromium, it glows with the deep red of a ruby. A trace of titanium gives us a blue sapphire. But not all sapphires are clear stones. Titanium dioxide may form a network of tiny whiskers within the stone giving us a 'star sapphire' showing a six-rayed star.

Cat's eye is a variant of the mineral beryllium aluminate (BeAl_2O_4). All the other gemstones are also common minerals, coloured by impurities. Emeralds are a variety of the mineral beryl ($\text{Be}_3\text{Al}_2(\text{SiO}_3)_6$) coloured green by trace amounts of chromium and sometimes vanadium. Topaz is a fluorine-containing aluminium silicate mineral, $\text{Al}_2\text{SiO}_4(\text{F},\text{OH})_2$. Pure topaz is transparent but is usually tinted by impurities; typical topaz is wine or straw-yellow.

Gemstones like corals and pearls are not minerals but products of living organisms. Corals live at depths of between 3 and 300 metres in the waters around Japan, Taiwan and in the Malaysian Archipelago, in the Red Sea, in the Bay of Biscay and around the Canary Islands, as well as in north-east Australia and the Midway Islands. In the Mediterranean, there are coral banks in the Tyrrhenian Sea, off the coast of Sardinia, off Tunisia and Algeria, former Yugoslavia and Turkey. Gemstone 'coral' is actually the hard stony skeleton of coral that has a delicate red or pink colour and is used for jewellery. Corals do not necessarily have to be red, even if red is thought of as their typical colour.

Pearls are also organic gems, created when an oyster covers a foreign object with beautiful layers of nacre. Long ago, thousands of oysters had to be searched for just one pearl. They were rare because they were created only by chance. Today pearls are cultured by man. Shell beads are placed inside an oyster and the oyster is returned to the water. When the pearls are later harvested, the oyster has

covered the bead with layers of nacre—the iridescent internal layer of a mollusc shell, also known as 'mother of pearl'. Interestingly, both pearls and corals are products of the water, chemically closely related with each other, and both consist of more than 90 per cent calcium carbonate.

Why the Interest in Astrological Gemstones?

Astrologers would like go to any extent to convince their clients why gemstones are good for them. Here is an example of their arguments:

The stars in their constant movements throughout the heavens are constantly emitting both positive and negative magnetic vibrations. Gems are similar to a lightning rod. They create, what is in effect, a protective field around the body, regulating the cosmic forces as absorbed by the body. In time, the proper gemstones, if kept in contact with the skin, can bring about changes in the mind and body.

The problem here is that the assertions of astrologers about the effects of gemstones are so vague that they hardly make any sense. For example, what does one mean by 'positive and negative magnetic vibrations' that stars are supposed to be emitting? How does a gemstone create a 'protective field around the body'? What are the 'cosmic forces' that are supposed to be absorbed by the body? Astrologers have no convincing answer.

Astrologers would even have us believe that gemstones are capable of curing any kind of disorder including chronic diseases like migraine, asthma, heart problems, tumours, spinal and backaches, blood pressure, stomach disorders, kidney stones, piles, arthritis, and epilepsy, although they do not have any clue as to how they work. There is no scientific evidence to support the claim of astrologers that wearing a gemstone can change the course of a disease; at most it may work in cases of certain psychosomatic disorders by providing false assurance to the patient.

Some of the claims of astrologers about how gemstones work appear preposterous. Here is an example:

The seven colours red, yellow, green, blue, violet, indigo and orange of different wavelengths have different governance on the system of body. Blue colour energy represents the spiritual aspects of the life and that is an endless process. It has greatest healing power that controls the activity of brain. It gives resistance to body against poison, evil effect, germs and reduces pain, etc. It helps the person for higher studies and research work. Indigo colour energy stands for unity, honesty and gentleness. It calms nerves and lymphatic systems; improves stomach disorders, migraine, and cataract; has soothing effect on the eyes, ears and the nervous system; gives vitamin K; and controls pituitary glands. Orange colour energy is a mixture of red and yellow that denotes the colour of Saint. Physically orange is the best stimulant, helping us in times of depression, loneliness, and boredom.

The above claims appear grossly exaggerated because perception of colour and its effect on the mind are very subjective; the same colour may appear pleasing to one person but irritating to another. Although it has been suggested that specific colours can have a therapeutic effect on physical and mental disabilities, these medical benefits are still in question, and there is no medical evidence to show that the colour from a gemstone falling merely on a tiny patch of skin can evoke the same kind of reaction or any of the reactions mentioned above.

Even if one accepts that wearing gemstones does have influence then one also needs to know the mechanism by which specific gemstones can overcome the 'evil influence' of planets, including health problems, as claimed by astrologers. Mere assertions cannot form the basis of any scientific discipline.

Big Business

Gemstones no doubt are rare and have aesthetic value. That is why they are so expensive and so much sought after. They look good on jewellery and form an essential component of contemporary fashion. Diamond and rubies also find wide use in industry as cutting and grinding tools and as bearings in precision machinery. But there is no known scientific mechanism to convince us that wearing a gemstone can bring good luck or ward off danger or the 'evil' influence of planets. In fact, there is nothing in gemstones to endow them with magical or healing powers that can act merely by contact. Yet, thanks to human fear, greed and gullibility, astrological gemstones are big business today.

It is surprising that even well-educated people including people trained in science believe in astrologers' assertions that wearing a gemstone can forestall a tragedy and bring good luck. Goaded by astrologers, they would go to any extent to buy the most expensive gemstone to assure good luck. What is interesting is that invariably the recommended gemstone has to be bought only from the jeweller recommended by the astrologer; even the purest gemstones bought elsewhere (State government emporia, for example) would invariably have *doshas* and would not work! In fact, gemstones have become such a lucrative business that most jewellery shops today have astrologers on call to recommend gemstones for their clients.

Do Gemstones Really Work?

It is difficult to prove or disprove whether gemstones really work in changing fortunes for the simple reason that it is impossible to prove that the same course of events would have followed even without gemstones. For example, if an astrologer advises, say, 1,500 unemployed youths to wear topaz to ensure employment then, statistically, around 750 of them would in any way get a job in due course, whether

they wore the recommended gemstone or not. But those who do get a job would be convinced that it is due the effect of the gemstone. Those who do not succeed may forget about it or keep trying. So would also be the case with parents seeking marriage of their sons or daughters, or businessmen facing losses in business, or patients suffering from chronic illnesses, and so on. In all these cases, as one can easily see, there could be only two possibilities and statistically, half of the predictions would come true anyway, gemstone or no gemstone. If gemstones really worked no businessman would ever suffer a loss and no politician would suffer defeat at the polls, which is obviously not the case.

Unfortunately, well-educated people, and even scientists, fail to understand this simple logic and fall for expensive gemstones as a panacea for their problems. They do not realise that diseases, failures or successes in life, and profits or losses in business are caused by identifiable factors that can often be controlled, for example, by proper hygiene, careful planning, and diligence. Gemstones cannot compensate for incompetence, imprudence, or personal likes and dislikes. Unless people themselves begin to think rationally and stop going after quick fixes for all their problems, the situation is not likely to change. The gainer, incidentally, are not those seeking relief through astrology and gemstones, but only the astrologers and gemstone sellers themselves.

Epilogue

After all that has been stated in the preceding chapters, one may ask: If astrology does not make sense why do so many people believe in it? The simple answer to this question would be: People believe in astrology because they are afraid of the unknown—about their own future and the future of their near and dear ones—and are ready to give up rational thinking to achieve the unachievable.

I know of a family which went to extremes, spending a few lakhs, to propitiate certain gods on the advice of astrologers to save a sick child suffering from leukaemia. Of course, the child did not live long, because childhood leukaemia patients rarely survive beyond a couple of years, even after extensive treatment. May be the parents had the emotional satisfaction of having done 'everything' to save the child, but that in no way can justify their irrational act that only helps perpetuate this social evil. The solution of a medical problem can only be found in medical science; soothsayers and astrologers can only give false hopes.

Take another example. There are astrologers who would scare the parents of a bride-to-be into believing that unless they perform certain rituals (for a hefty sum), as ordained in the scriptures, the girl would lose her husband within a few months of the marriage. No parent would have the courage to take in such an omen lightly, although it amounts to nothing less than psychological blackmail. Unfortunately, there is no way one could disprove that rituals do not make

any difference to the survival of individuals.

The American author Michael Shermer, the founding publisher of *Skeptic* magazine, writes in his bestseller *Why People Believe Weird Things*:

In my opinion, most believers in miracles, monsters and mysteries are not hoaxes or lunatics. Most are normal people whose normal thinking has gone wrong in some way.

Life is contingent and filled with uncertainties, the most frightening of which is the manner, time, and place of our own demise. For a parent, an even worse fear is the death of one's child, which makes those who have suffered such a loss especially vulnerable to what "psychics" offer. Under the pressure of reality, we become credulous. We seek reassuring certainties from fortune-tellers and palm readers, astrologers and psychics. Our critical faculties break down under the onslaught of promises and hopes offered to assuage life's great anxieties.

So we know why people believe in astrology, often knowing well that it is a pseudoscience—in the hope of assuaging life's great anxieties. We humans—being emotional creatures—each have our own fears and ambitions that astrologers exploit to the hilt. At times of distress, people usually fail to think rationally and fail to gather up enough courage to seek a rational solution. Instead, they flock to temples and astrologers in search of solutions that can only be reached by rational thinking. Surprisingly, we live in an age of science and most of us harbour a type of faith in science. We believe that somehow science will solve our problem—AIDS, cancer, pollution, heart disease, and so on—that no god or astrologer could possibly ever find solutions to.

Our best weapons to fight obscurantist practices like astrology come from the arsenals of basic scientific

procedures—for nothing can beat the basic experimental technique of the double-blind procedure and the fundamental observational methods of statistical analysis, as we have seen. Almost every modern irrationalism can be defeated by these most elementary scientific tools. But to do that we need to create greater public awareness and that is what this book seeks to achieve.